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Introduction

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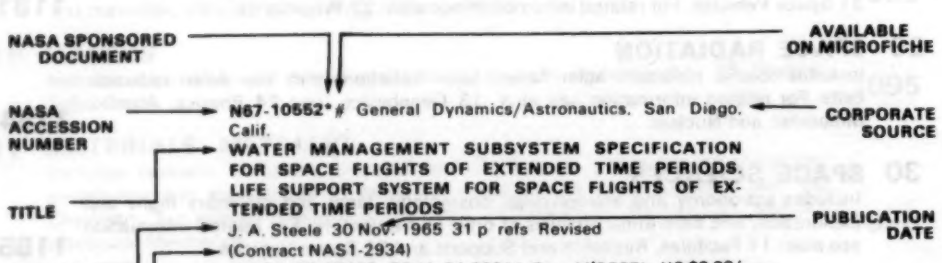
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N67-10552*# General Dynamics/Astronautics, San Diego, Calif.
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TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
AUTHOR
J. A. Steele 30 Nov. 1965 31 p refs Revised
(Contract NAS1-2934)
CONTRACT OR GRANT
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $3.00/ MF $0.65 CSCL 06K
SALES AGENCY AND PRICE
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.
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VOLUME 5 NUMBER 7

Scientific and Technical Aerospace Reports

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April 8, 1967

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N67-16777# Aeronautical Research Council (Gt. Brit.)
SOME STUDIES OF PRESSURE DISTRIBUTIONS ON THE WINDWARD SURFACES OF CONICAL BODIES AT HIGH SUPERSONIC SPEEDS
A. Akers London, HMSO, 1966 22 p refs Supersedes RAE-TN-AERO-2911; ARC-25346; See X64-11339
(ARC-CP-723; RAE-TN-AERO-2911; ARC-25346; AD-800210) CFSTI: HC $3.00/MF $0.65

A study is reported of the results of pressure measurements on conical lifting bodies, of various cross-sections, at high supersonic Mach numbers. TAB

N67-16800# Lockheed-Georgia Co., Marietta.
METHODS FOR ANALYSIS OF TWO-DIMENSIONAL AIRFOILS WITH SUBSONIC AND TRANSONIC APPLICATIONS
1 Nov. 1966 77 p refs
(Contract DA-31-124-ARO(D)-398)
(ER-8591; AROD-6074-1; AD-642750) CFSTI: HC $3.00/MF $0.65

The report is an addendum to AD-637 603 and consists primarily of a FORTRAN program for analyzing the airfoils. TAB

N67-16821# Princeton Univ., N. J.
THE LEADING EDGE EFFECT ON THE FLOW OVER A FLAT PLATE AT M = 10
J. C. Townsend, W. R. Vollmar, and I. E. Vas Wright-Patterson AFB, Ohio, ARL, Jul. 1966 70 p refs
(Contract AF 33(616)-7629)
(ARL-66-0145; Rept.-767; AD-642436) CFSTI: HC $3.00/MF $0.65

A study of the leading edge effects on the flow over a flat plate was made at a Mach number of 10. The Reynolds number based on free stream conditions and leading edge thickness varied from 115, where viscous effects predominated, to 14,550, where inviscid effects predominated. Shock wave shape and pressure and heat transfer distributions over the plate were obtained. In general, good agreement existed between the measurements and the various theories. The use of appropriate parameters allowed the results to be compared with those of a similar study using helium as the test fluid. Good correlation was found between the measurements made in air and in helium. Author (TAB)

N67-16978# Air Force Systems Command, Wright-Patterson AFB, Ohio.
CORRELATION OF ANALYTICAL AND EMPIRICAL TECHNIQUES FOR DESIGNING SUPERSONIC AND HYPERSONIC DECELERATORS
Fredrick Bloetscher (Goodyear Aerospace Corp.) and William R. Pinnell *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 39 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

Design techniques for three classes of aerodynamic decelerators were evaluated. Test results and correlations are presented for: (1) Small supersonic parachutes. Analytical approaches for establishing configurations for the supersonic regime to Mach 56 are presented. First-order correlations between the results of analytical approaches, wind-tunnel tests, and flight tests behind symmetrical bodies are discussed. (2) Reefed, high dynamic pressure parachutes. A low-porosity configuration established by wind-tunnel tests having predictable drag loads when highly reefed is described. (3) Inflatable decelerators. Free-flight and full-scale wind-tunnel tests of flight hardware have demonstrated the ability to design both textile and metal cloth inflatable devices for operating behind both symmetrical and asymmetrical payloads. Author

N67-16979# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Hypersonic Research Lab.
BLAST WAVE EFFECTS ON THE PITCHING OF BLUNT CONES
Brian P. Quinn *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 30 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

The flow around a blunted slender cone performing pitching oscillations is theoretically analyzed by means of Chernyi's blast-wave piston analogy. Stationary and transient shock shapes and pressure distributions are presented in power series form. Within the region of applicability, the stationary pressure agrees well with Chernyi's numerical integration. Normal force and pitching moment coefficient derivatives are presented and the results are plotted for a 10° cone. The theoretical static and dynamic stability derivatives agree satisfactorily with recent experiments in a Mach 14 wind tunnel. It is concluded that the experimentally observed reduction

in static and dynamic stability due to increased nose bluntness may be attributed to blast wave effects. Author

N67-17173*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT DEMONSTRATION OF A SKIN-FRICTION GAGE TO A LOCAL MACH NUMBER OF 4.9
Darwin J. Garringer and Edwin J. Saltzman Washington, NASA, Feb. 1967 27 p refs
(NASA-TN-D-3830) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A small, commercially available skin friction gauge was flight tested on the X-15 airplane. The Reynolds number range investigated extended from 3.3×10^6 to 8.0×10^6, and local Mach numbers ranged from 0.7 to 4.9. The ratio of wall-to-recovery temperature varied from about 0.4 to 1.4. The gauge, its cooling system, and the supporting instrumentation performed well. Turbulent skin friction values measured in flight for a wide range of wall-to-recovery temperature ratios are similar in level to adiabatic flat plate wind tunnel results for corresponding Mach numbers and Reynolds numbers. Thus, for the present tests the influence of wall-to-recovery temperature ratio appears to be less than estimated by turbulent theory. Author

N67-17186*# Alpha Research, Inc., Santa Barbara, Calif.
AERODYNAMIC STUDIES OF NON-PLANAR AND NEAR-CIRCULAR MOTIONS Summary Report
James E. Brunk 15 Dec. 1966 75 p refs
(Contract NAS2-3426)
(NASA-CR-73067; Rept.-66-3426-1) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The polar equation of yawing motion was used to analyze non-planar and near-circular motions of symmetric missiles, both with and without axial spin. Nonlinear damping moments, various Magnus effects, and other aerodynamic nonlinearities were expanded into coefficients related to the angle of attack and Magnus planes. The simultaneous effect of both these terms and the nonlinear inertial moments, on the amplitude, frequency, and stability of circular limit motions was then determined by perturbation analysis. It was concluded that circular limit cycles were possible for all axi-symmetric missiles which possess a Magnus moment of sufficient magnitude. G.G.

N67-17256 National Physical Lab., Teddington (England). Aerodynamics Div.
ALGOL 60 PROGRAMME FOR MULTHOPP'S LOW-FREQUENCY SUBSONIC LIFTING-SURFACE THEORY
H. C. Garner and D. A. Fox 15 Apr. 1966 51 p refs
(NPL-AERO-1192; ARC-27926)

An improved program for the KDF9 digital computer is described and illustrated. The mathematical equations, general flow diagrams, and Algol text are presented. The improvements incorporate a new procedure for evaluating the influence functions and a scheme for more accurate spanwise integration without increase in the number of collocation sections. Up to four chordwise terms are included, but the extension to five or more terms should be straightforward in principle. Author

N67-17331 National Physical Lab., Teddington (England). Aerodynamics Div.
THE VARIATION OF PROFILE DRAG WITH MACH NUMBER UP TO THE CRITICAL VALUE; A COMPARISON OF RECENT PREDICTIONS WITH EARLY FLIGHT AND WIND-TUNNEL MEASUREMENTS, AND A COMMENT ON AN EARLIER PREDICTION
J. Osborne 20 Jun. 1966 32 p refs
(NPL-AERO-1197; ARC-28107)

Flight measurements with the wake traverse method are used to extend to high Reynolds numbers (2×10^7) and a thick section (18% t/c) the verification that the sub-critical creep in profile-drag coefficient can now be predicted accurately. Good agreement is also obtained between the absolute magnitude of the measured drag and of that predicted on the basis of boundary-layer transition having occurred near the leading edge. Similar agreement is obtained with a drag coefficient measured on a two-dimensional aerofoil ($R = 0{\cdot}6\times10^6$) of an almost identical section with transition positions now known to have been at 39% chord. The analysis shows that predicted profile drag, particularly at high sub-critical Mach numbers, is sensitive to the actual compressible-flow pressure distribution used in its derivation, and that the errors due to inaccuracies of the older compressibility laws can be especially important for sections of this thickness, with the particular type of velocity distribution involved. Author

N67-17347# Aeronautical Research Council (Gt. Brit.)
AN ANALYSIS OF THE SUBSONIC FLOW PAST SYMMETRICAL BLUNT-TRAILING-EDGE AEROFOIL SECTIONS AT ZERO INCIDENCE, IN THE ABSENCE OF A VORTEX STREET
J. F. Nash London, HMSO, 1966 45 p refs Supersedes NPL-AERO-1112; ARC-26117
(ARC-R&M-3436; NPL-AERO-1112; ARC-26117) CSFTI: HC $3.00/MF $0.65

A simplified analysis is presented of the subsonic non-periodic flow past symmetrical blunt trailing edge sections at zero incidence. The pressure distribution is determined with the base pressure as parameter by an analysis of the inviscid flow past a displacement surface representing the section, the attached boundary layer, and the wake. The shape of the downstream part of the displacement surface presented by the wake is specified by pressure criteria established from a study of the pressure distribution downstream of a rearward facing step. The solution is rendered unique by the estimation of the base pressure. An analysis is made of the flow in the wake invoking the condition that the wake momentum thickness must asymptote to a value at infinity downstream which is proportional to the total drag of the section. The viscous solution can be regarded as a logical extension to blunt trailing edge sections of the method of Squire and Young for the estimation of the drag of conventional airfoils. A few examples are submitted to illustrate the application of the method. Author

N67-17360*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INFLUENCE OF UPSTREAM FLOW DISCONTINUITIES ON THE ACOUSTIC POWER RADIATED BY A MODEL AIR JET
Colin G. Gordon and Gideon Maidanik Washington, NASA, Jan. 1967 135 p refs
(Contract NAS1-4974)
(NASA-CR-679) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Results are presented of an experimental study of the sound-radiation changes produced by inserting a flow spoiler into a model air jet, a short distance upstream from the exit plane of the jet pipe. The work is restricted to the broad-band sound radiation at subsonic flow velocities. Spoiler-generated noise is shown to be dipole in character and displays a dependence upon the sixth-power-of-flow velocity. It dominates the total noise radiation from the typical model jet system over most of the velocity range. The results of measurements on a large variety of flow spoilers have shown that the total and spectral power may be described empirically in terms of easily measured parameters of the geometry and air flow. This empirical formulism correlates well with a semitheoretical model of dipole noise. Some of the results show significant deviation from a well-behaved dipole model. It is postulated that in-pipe quadrupole sources are active under certain, as yet undefined, conditions. A tentative formulation shows how such secondary sources may fit into a prediction scheme. Author

N67-17380# Aeronautical Research Council (Gt. Brit.)
THE THEORETICAL STABILITY DERIVATIVES FOR A SYMMETRICALLY TAPERED WING OF ASPECT-RATIO 3 AT SUPERSONIC SPEEDS
Doris E. Lehrian 1966 12 p refs Supersedes NPL-AERO-1026, ARC-25889
(ARC-CP-855; NPL-AERO-1026; ARC-25889) CSFTI: HC $3.00/MF $0.65

Heaving and pitching derivatives are calculated to first order in frequency on the basis of linearized oscillatory theory. Derivatives are tabulated for six Mach numbers in the range $1{\cdot}0.31 \leq M \leq 1{\cdot}875$. Some comparisons are made with transonic and supersonic experimental results and with other theoretical values. Author

N67-17622*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DATA ON A LARGE SEMISPAN TILTING WING WITH A 0.5-DIAMETER CHORD, A SINGLE-SLOTTED FLAP AND BOTH LEFT-HAND AND RIGHT-HAND ROTATION OF A SINGLE PROPELLER
Marvin P. Fink and Robert G. Mitchell Washington, NASA, Feb. 1967 159 p refs
(NASA-TN-D-3754) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Longitudinal aerodynamic characteristics of a large-scale semispan V/STOL tilt-wing configuration having a single propeller rotating in both left- and right-hand directions were studied. The wind had a chord-to-propeller-diameter ratio of 0.5, a 40% chord single-slotted flap, an aspect ratio of 4.88, a taper ratio of 1.0, and an NACA 4415 airfoil section. Preliminary analysis indicated that the direction of propeller rotation had a very significant effect on the lift and descent capability, and that up-at-the-tip (right-hand) rotation gave more favorable results. A trailing edge flap was effective in increasing the descent capability; leading edge flow control devices were effective in increasing the descent capability and lift for the down-at-the-tip (left-hand) propeller rotation, but were much less effective up-at-the-tip propeller rotation where reasonably favorable results were achieved without leading edge devices. For the most favorable combination of the configuration variables (a full-span slat, 60° flap deflection, and fences on), descent angles of 20° or more were achieved over the entire test range of power conditions. Author

N67-17636* Bell Helicopter Co., Fort Worth, Tex.
EXPLORATORY WIND TUNNEL TESTS OF THE NASA-BELL RECOVERY ROTOR
L. H. Erb 5 Aug. 1966 60 p refs
(Contract NAS2-1165)
(NASA-CR-73065; Rept.-543-099-004) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Problem areas, operation, and test techniques are defined for the recovery rotor concept in axial flow. A 25-foot dia rotor was designed and fabricated to test large-scale effects of dynamics, aerodynamics, control, and structural stresses; and a summary is presented of exploratory wind tunnel tests restricted to low rotor loads. The rotor was deployed from high coning angles and was operated in the feathered, helicopter-type, recirculation, and stalled regions of autorotational equilibrium. Tip brakes permitted tests at higher coning angles, and higher tunnel speeds were possible without overspeeding the rotor. Since no problems in rotor control were encountered, credence is given to the pilot's ability to control the overspeed tendency of the recovery rotor concept. Deceleration capability and cyclic pitch control are discussed, as are collective transients and deployments. M.W.R.

N67-17721 Aeronautical Research Council (Gt. Brit.)
LOW-SPEED WIND-TUNNEL MEASUREMENTS OF THE LIFT, DRAG AND PITCHING MOMENT ON THREE SYMMETRICAL OGEE-WING MODELS AND ON A SYMMETRICAL SLENDER WING-BODY MODEL
D. A. Kirby London, HMSO, 1966 45 p refs Supersedes RAE-TN-AERO-2927; ARC-25709
(ARC-CP-846; RAE-TN-AERO-2927; ARC-25709) HMSO: 8s

Measurements have been made of the lift, drag, and pitching moment of three ogee models and a wing-body model, all having a slenderness ratio of 0.209. The associated surface flow patterns were also observed. Although the models were symmetrical and did not represent strictly comparable fully optimised designs of possible layouts for a supersonic transport, some useful low-speed aerodynamic comparisons between the integrated or ogee models and the wing-body were obtained. The results show very similar lift characteristics, a slightly smaller drag for the wing-body model, and better static longitudinal stability characteristics for the wing-body model, especially when the wing planform was not faired smoothly into the body. Attempts to improve the longitudinal stability of one of the ogee wings, by minor planform modifications at the rear of the wing intended to reduce the forward movement of aerodynamic centre with incidence, were largely unsuccessful, but provided some useful data on the effect of trailing-edge shape. For the wing-body model, dropping the nose was a successful modification. Author

N67-17722# Aeronautical Research Council (Gt. Brit.)
THE PROBLEM OF PANEL FLUTTER WITH REFERENCE TO THE BLUE STREAK AND BLACK KNIGHT VEHICLES
G. Z. Harris London, HMSO, 1966 21 p refs Supersedes RAE-TN-STRUCT-296; ARC-23090
(ARC-CP-848; RAE-TN-STRUCT-296; ARC-23090) HMSO: 5s

The problem of panel flutter is discussed, and the theory of Miles for cylindrical panels is applied in assessing the panel flutter problem on the Blue Streak and Black Knight vehicles. Author

N67-17754# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
INVESTIGATION OF THE PRESSURE DISTRIBUTION ON A BLUNT-FIN BLUNT-PLATE COMBINATION AT A MACH NUMBER OF 11.26
John P. Thomas Jul. 1966 199 p refs
(ARL-66-0142; AD-642435) CFSTI: HC $3.00/MF $0.65

The purpose of the investigation was to determine the pressure field on a blunt flat plate in the vicinity of the junction of a three-dimensional fin-plate combination. For the investigation to cover a broad spectrum of configurations, different plate angles of attack, various fin yaw angles, and two fin yaw angles were employed. The investigation was divided into two parts. In the first part, the experimental pressures on a blunt flat plate were measured with and without a blunt fin mounted between the centerline and the trailing edge of the flat plate. In the investigation the plate had an angle of attack of zero or 10 degrees compression. The fin-plate pressure data were obtained for a 45 degree swept and unswept blunt fin at zero and 10 degree fin yaw angle. Both the plate and the fin had hemicylindrical leading and trailing edges. All of the data were taken at a Mach number of 11.26 and Re sub d of 6300. The second part of the investigation consisted of the development of an analytical method of predicting Mach numbers and flat plate pressures for the same configuration. The analytical method was based on a simplified Lees and Reeves solution of the boundary layer-shock interaction problem extended to three dimensions by use of a two-dimensional strip analysis. Author (TAB)

N67-17762# Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENT ON AERODYNAMIC NOZZLES AT $M=2$
J. Reid London, HMSO, 1964 36 p refs Supersedes RAE-AERO-2672; ARC-24845; see X63-13094
(ARC-R&M-3382; RAE-AERO-2672; ARC-24845) HMSO: 15s

In an aerodynamic nozzle a convergent primary nozzle is housed within an afterbody which is surrounded by a shroud. Part

of the external flow is captured thereby and compressed by the under-expanded primary jet. At the design point this system is not as efficient as a convergent–divergent nozzle but its off-design performance should be better. In the experiment axisymmetric models were used. The shrouds were cylindrical externally and either cylindrical or convergent–divergent internally. With each model the thrust and afterbody pressure distributions were measured at jet pressure ratios up to 20 with a free-stream Mach number of 2.0. Component drags were estimated indirectly from these measurements. For comparison, the thrust of unshrouded convergent and convergent–divergent nozzles was measured under the same conditions. With the cylindrical shrouds the effects of shroud length, shroud diameter and boundary-layer thickness were investigated. The greatest thrust developed by these models was about 5% less than that of the equivalent convergent–divergent nozzle. With the convergent–divergent shrouds the main variable studied was the ratio shroud throat area/shroud exit area. The thrust of the best model was some 9% less than that of the convergent–divergent reference nozzle. In the case of one cylindrical shroud the internal flow was studied in detail by surface pressure measurements and radial traverses. Author

N67-17868# Aeronautical Research Council (Gt. Brit.)
EXPERIMENTAL PRESSURE DISTRIBUTIONS ON A PLANE-NOSED CYLINDER AT SUBSONIC AND TRANSONIC SPEEDS
A. Stanbrook London, HMSO, 1966 42 p refs Supersedes RAE-TN-AERO-2876; ARC-25150; See X63-14965
(ARC-R&M-3425; RAE-TN-AERO-2876; ARC-25150) CFSTI: HC $3.00/MF $0.65

The pressure distribution over a plane-nosed cylinder has been measured at Mach numbers from 0.7 to 0.95 at incidences from 0 to 10 and up to M=1.2 at zero incidence. The effect of Reynolds number was studied to a limited extent. The results have been analysed to yield drag at zero incidence and pitching moment on the front face together with normal-force distribution along the cylinder. Author (TAB)

N67-17877 Aeronautical Research Council (Gt. Brit.).
SOME EXPLORATORY MEASUREMENTS OF LEADING-EDGE VORTEX POSITIONS ON A DELTA WING OSCILLATING IN HEAVE
R. L. Maltby, P. B. Engler, R. F. A. Keating, and G. F. Moss London, HMSO, 1965 32 p refs Supersedes RAE-TN-AERO-2903; ARC-25269; See X64-10115
(ARC-R&M-3410; RAE-TN-AERO-2903; ARC-25269) CFSTI: HC $3.00

Some measurements of vortex-core height for a heaving delta wing at high incidence are presented. A method of flow visualization using smoke was specially developed for this investigation, and a simple theory for the appearance of the smoke display is included. In the original analysis, given in the main body of the report, a phase lag of 60° was found between the height of the vortex core and the heaving motion at a frequency parameter of 3-4. In a subsequent reanalysis of the data, a more detailed comparison with theory is shown along with the results of extra measurements made with pressure transducers. Author

N67-17901 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
EFFICIENCY AND KINETIC HEATING OF AERODYNAMIC CONTROL DEVICES IN HYPERSONIC FLOW [EFFICACITE ET ECHAUFFEMENT DE GOUVERNES EN HYPERSONIQUE]
Philippe Poisson-Quinton and Rene Ceresuela 1966 56 p refs In FRENCH, ENGLISH summary Presented at the 5th Intern. Council of the Aeronautical Sci. (ICAS), London, 12–16 Sep. 1966
(ONERA-TP-385/1966/) CFSTI: HC $3.00/MF $0.65

An experimental study of the problem of strong viscous interactions and heating in the regions of the control devices during a piloted lifting reentry or flight of hypersonic airplanes is reported. The experiment was carried out on a basic zero-sweep flat plate in a Mach 10 facility. Three types of control systems (elevon, spoiler, and jet) were compared using pressure and wall temperature measurements as well as schlieren flow visualization and visual heating detection. The leading edge bluntness effect was investigated with and without transition promoting strips, and measurements were made for various angles of attack, elevon deflection, spoiler heights, and jet thrusts to obtain an integrated value of the aerodynamic and thermal loads. Results indicated that for each of the control types a nearly linear relation exists between the aerodynamic and thermal loads; however, the most efficient of these devices was considered to be the jet for a given thermal load. Author

N67-17907# RAND Corp., Santa Monica, Calif.
NEWTONIAN SNOWPLOW THEORY OF OSCILLATING AIRFOILS
J. Aroesty, A. F. Charwat, S. Y. Chen, and J. D. Cole May 1966 20 p refs
(Contract ARPA SD-79; ARPA Order 189-1)
(RM-4415-ARPA; AD-633971) CFSTI: HC $3.00/MF $0.65

Unsteady forces acting on two-dimensional oscillating airfoils are calculated by Newtonian snowplow theory. A pressure formula which is valid for linear and nonlinear oscillations is obtained, and comparisons are made with the exact, linearized gasdynamic theory for a hypersonic slender wedge. These comparisons indicate that Newtonian theory is not very accurate for the calculation of unsteady stability derivatives and seems to be inferior to estimates made using simple impact theory. Author (TAB)

N67-18001* Jet Propulsion Lab., Calif. Inst. of Tech., Cambridge.
STATIC AERODYNAMIC CHARACTERISTICS OF POSSIBLE PLANETARY ENTRY CONFIGURATIONS AT MACH-NUMBER 4.54
Edward Nierengarten 15 May 1965 70 p refs
(Contract NAS7-100)
(NASA-CR-81647; WT-20-559) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation is reported of a supersonic wind tunnel test to obtain basic aerodynamic force data in the mid angle-of-attack region, 50 to 110 deg, for a series of blunt configurations and to compare these results with Newtonian impact theory. The tests were also conducted to obtain force data on three proposed nose configurations at low angle of attack and to confirm experimental data on some previously tested highly blunt cones. Details are given on the three groups of configurations, the wind tunnel and instrumentation, test procedures, and data reduction. The aerodynamic data were recorded and reduced to coefficient form and plotted as a function of angle of attack. The results are presented in graphical and tabular form. L.E.W.

N67-18031* Illinois Univ., Urbana.
DRAG FORCES OF TWO-DIMENSIONAL V-SHAPED NOTCHES IN TRANSONIC AND SUPERSONIC TURBULENT FLOW
Ronald Hunter Howell (Ph.D. Thesis) [1967] 175 p refs
(Grant NsG 13-59)
(NASA-CR-81691) CFSTI: HC $3.00 CSCL 01A

The increase in the drag force due to the presence of a v-shaped notch in a flat surface was analyzed. For the problem considered, the wall geometry was two-dimensional and remained restricted to symmetrical notches; the approaching boundary layer was always turbulent; and the external transonic or supersonic flow was adiabatic and compressible. Details are given on the construction of a balance to measure directly the drag force, and designed so that various two-dimensional configurations could be installed and their drag forces measured. Blowdown type wind tunnel tests were conducted to evaluate the effects of notch

geometry, Mach number, Reynolds number, and shear layer thickness on the drag force. The results are assessed, and the data obtained indicate a displacement and a smoothing out of the theoretical maximum value of the drag coefficient near Mach number equal to one. A literature review is also presented, with summary information given on the rectangular notch drag, interactions between component flow regimes, and surface skin friction. M.G.J.

N67-18109# Aeronautical Research Council (Gt. Brit.).
TORSIONAL FLUTTER OF UNSTALLED CASCADE BLADES AT ZERO DEFLECTION
D. S. Whitehead (Cambridge Univ.) London, HMSO, 1966 34 p refs Supersedes ARC-26085; see X64-15606
(ARC-R&M-3429; ARC-26085) CFSTI: HC $3.00/MF $0.65

Results are presented of theoretical calculations of torsional flutter of unstalled cascade blades. It is shown that the position of the torsional axis is of great importance; the best position being near the quarter-chord point, and the worst position near the three-quarter-chord point. An unfavorable axis position gives flutter speeds which are exceeded in normal machines. An experimental investigation in an annular cascade with twelve blades confirms the existence of this type of flutter. Good agreement with theory is found in some cases, but in others it is thought that three-dimensional effects are having a substantial influence. Author

N67-18118# Aeronautical Research Council (Gt. Brit.).
MERCURY PROGRAMMES FOR LIFTING SURFACE THEORY CALCULATIONS ON WINGS OSCILLATING IN SUPERSONIC FLOW
G. Z. Harris London, HMSO, 1966 64 p refs Supersedes RAE-TR-64064; ARC-26839; see X65-15469
(ARC-CP-851; RAE-TR-64064; ARC-26839) CFSTI: HC $3.00/MF $0.65

Programs for lifting surface theory calculations on wings oscillating in supersonic flow are described. The computation falls into two parts: one finding the complex influence matrices connecting lift and downwash, and the other finding the generalized forces when the influence matrixes are given as data. The numerical method is described, and values of constants used in the calculations are given. Author

N67-18133*# Rice Univ., Houston, Tex. Dept. of Mechanical and Aerospace Engineering and Materials.
OPTIMUM HYPERSONIC LIFTING WINGS Progress Report, 1 Jul.–31 Dec. 1966
Angelo Miele 31 Dec. 1966 5 p refs
(Grant NGR-44-006-045)
(NASA-CR-81789) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Both the direct, and the indirect methods (of one and two independent variables) of investigating the optimum two-dimensional or three-dimensional lifting wings in hypersonic flow are reported. The methods of the theory of maxima and minima and those of the calculus of variations are used in order to maximize the lift-to-drag ratio for given geometric and aerodynamic constraints. Since flat-top wings are naturally suited to produce high lift-to-drag ratios at hypersonic speeds, particular attention is devoted to these wings under the assumptions that the free-stream velocity is parallel to the flat top, the pressure distribution is modified Newtonian, and the surface-averaged skin-friction coefficient is constant. R.L.I.

N67-18142*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS AT MACH 2.03 OF A SERIES OF CURVED-LEADING-EDGE WINGS EMPLOYING VARIOUS DEGREES OF TWIST AND CAMBER
Barrett L. Shrout Washington, NASA, Feb. 1967 23 p refs
(NASA-TN-D-3827) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A series of curved leading edge wings employing various degrees of twist and camber was tested in a 4- by 4-foot supersonic pressure tunnel at a Mach number of 2.03 and a Reynolds number, based on the mean geometric chord, of 4.4×10^6. The results are compared with theoretical predictions. Maximum lift-drag ratios predicted by theory were not attained experimentally although the wings twisted and cambered for an intermediate design lift coefficient yielded higher experimental values of maximum lift-drag ratio than did the corresponding flat wings. Comparison of the variation of some of the aerodynamic parameters with planform exponent K, which indicates the amount of curvature in the leading edge, showed an increase in lift-curve slope and a slight increase in stability with increasing K. In addition, there is a slight decrease in zero-lift pitching moment with increasing K for the twisted and cambered wings. Author

N67-18151*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW SUBSONIC STATIC AND DYNAMIC STABILITY CHARACTERISTICS OF TWO BLUNT 120° CONE CONFIGURATIONS
Richard J. Bendura Washington, NASA, Feb. 1967 23 p refs
(NASA-TN-D-3853) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Static and dynamic stability characteristics of flat based and conical based configurations were experimentally determined. Both configurations had a nose radius–base diameter ratio of 1/8. Two models of each configuration were tested: one model with the center of gravity in the vicinity of the nose and one model with the center of gravity near the maximum body diameter. The investigation was conducted with the flat-base configuration at a Mach number of 0.062 and Reynolds number of 0.58×10^6 based on maximum body diameter) and with the conical-base configuration at a Mach number of 0.057 and Reynolds number of 0.63×10^6. Both configurations were statically and dynamically stable for all center of gravity locations forward of the maximum base diameter. The conical afterbody had no significant effect on either the static stability or the dynamic stability. Author

N67-18158*# Wichita Univ., Kans.
FURTHER EXPERIMENTAL INVESTIGATIONS OF DELTA AND DOUBLE-DELTA WING FLOW FIELDS AT LOW SPEEDS
William H. Wentz, Jr. and Michael C. McMahon Washington, NASA, Feb. 1967 136 p refs
(Grant NGR-17-003-003)
(NASA-CR-714) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Low speed wind tunnel investigations were conducted to determine the nature of the flow fields and their relationship to aerodynamic forces. A semi-span double-delta model consisting of a forward panel having an 80° swept leading edge and a 62° swept main panel was tested at a Reynolds number per foot of 1.0×10^6. Detailed velocity vector measurements were made in the flow fields around the wing. Results are compared with flow field measurements about a 62° delta and a 75°/62° double-delta wing. Three-component force data, pressure distributions, and surface-tuft and oil-streak patterns are presented. Leading edge vortex sheet measurements are presented and compared with free streamline theory. Circulation integrals derived from the flow field maps are presented. Results indicate that vortex core breakdown is the source of the principal discrepancy between measured and theoretical lift. The lift prediction method of Poisson-Quinton accounts for the breakdown and seems to be the most satisfactory method of lift prediction available presently. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-16774*# Boeing Co., Seattle, Wash. Aerospace Group.
SUPERSONIC TRANSPORT TRAJECTORY OPTIMIZATION EXAMPLE SOLUTIONS Final Report
Lawrence H. Stein, Malcolm L. Matthews, and Joel W. Frenk Jan. 1967 281 p
(Contract NAS1-5293)
(NASA-CR-66247) CFSTI: HC $3.00/MF $0.65 CSCL 01B

A computer program for supersonic transport trajectory optimization was used to solve twenty optimization problems. The problems included one four-stage space booster mission, one optimal flight path for a variable-sweep reentry vehicle, and eighteen SST missions involving both fixed-wing and variable-sweep configurations. The SST missions involved various combinations of enroute constraints to account for engine limits, structural and cruise limits, and planar and area sonic-boom over-pressure restrictions. A discussion of each of the 20 problem solutions is presented. The problem statement, results, and a brief analysis are provided along with a computer listing of each optimal trajectory. Author

N67-16944# Air Force Flight Test Center, Edwards AFB, Calif. Flight Research Div.
ACCELERATIONS ON AIRCRAFT INDUCED BY THE EARTH'S ROTATION
Everett W. Dunlap and Milton B. Porter *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 49 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

A mathematical analysis is made of the accelerations which act on vehicles flying within the atmosphere. From this analysis, equations are extracted which describe the accelerations induced by the earth's rotational velocity. Factors which influence the magnitude of the effect of these accelerations on performance are: heading angle, latitude, weight, aerodynamic characteristics, and, most importantly, speed. Equations are developed to evaluate the consequence of varying heading angle and latitude on two performance parameters which are related to range (payload) and to the standardization of flight data. Sample calculations are included for a 300,000 pound airplane flying at Mach 3. As an example, the maximum variation in equilibrium cruise weight with latitude and heading angle is 8,800 pounds. For the same cruise conditions at 300,000 pounds and at 45 degrees latitude, the maximum variation in excess thrust with heading is 1,400 pounds. Author

N67-16958# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Applications Div.
FILAMENT WOUND AIRCRAFT TIRES
Theodore J. Reinhart, Jr. *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 35 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

The paper discusses the advantages, problem areas and future potential of continuous cross section tires as compared to conventional tires. Presented are discussions concerning the use of advanced tire materials and spin-off applications. It is concluded that the perfection of this tire configuration and its associated manufacturing technology will result in tires capable of sustained very high load operation, reductions in weight and increased reliability when compared to present day conventional tires. Author

N67-17112 Royal Aircraft Establishment, Farnborough (England). Instruments and Electrical Engineering Dept.
FLIGHT EXPERIENCE OF RATE DEMAND CONTROL USING ELECTRIC SIGNALLING IN THE AVRO 707C AIRCRAFT
G. C. Howell [1966] 17 p Presented at the AGARD Flight Mech. Panel Session I, 10 May 1966

A rate demand control system in pitch and roll is found to give all the advantages of a full authority autostabilizer as well as constant response to the control demands of the pilot when using electric signalling in the Avro 707C aircraft. This system simplifies artificial feed design, and permits a better maneuver limitation based on feedback control. A two-axis miniature controller permits a short response time, and pilot induced oscillations are reduced to a minimum. The electric signalling system with no mechanical reversion allows optimum design of this miniature controller. The control system is described, and the actual control equations for pitch and roll are given. Basic closed loop response of the aircraft control system is discussed, as are the handling qualities in generalized maneuvers. M.W.R.

N67-17376# Aeronautical Research Council (Gt. Brit.)
A SURVEY OF AIRCRAFT HANDLING CRITERIA
C. Leyman and E. R. Nuttall 1966 76 p refs
(ARC-CP-833) CFSTI: HC $3.00/MF $0.65

This note discusses the requirements for satisfactory and minimum acceptable handling qualities of aircraft. Published criteria based on various sources, e.g., variable stability aircraft and flight simulators, are compared and some present day aircraft examined in the light of the criteria. It is shown that some modification of the published criteria is necessary when large aircraft are considered, and that the criteria must in any case be used with due regard to the flight condition and aircraft role under consideration. Part I gives some background information on handling research and discusses pilot opinion rating scales. Parts II and III contain detailed surveys of longitudinal and lateral handling criteria respectively. Part IV discusses a theory of handling qualities based on a servo-analytical approach and Part V presents some broad conclusions. Author

N67-17673# Air Force Flight Test Center, Edwards AFB, Calif.
IMPORTANT VSTOL AIRCRAFT STABILITY DERIVATIVES IN HOVER AND TRANSITION
J. M. Rampy Oct. 1966 28 p ref
(FTC-TR-66-29; AD-641371) CFSTI: HC $3.00/MF $0.65

To design better ground test facilities and to specify handling qualities criteria, the aerodynamic parameters involved must be identified. The purpose of the study was to identify these parameters for the critical flight regime of hover through transition. Both analog and digital computers were used. The purpose of the analog simulation was to qualitatively analyze the behavior of VSTOL aircraft to control inputs and identify the most important derivatives. Two typical VSTOL aircraft were investigated. The method used to determine the important derivatives was that of varying the stability derivatives about some basic value. The amount of simulator response identified the most important derivatives. Next, the digital computer was used to affix a magnitude to the relative importance of each derivative. To establish the relative importance, a sensitivity factor was derived. The information necessary to calculate this factor was obtained from a mathematical analysis of the equations of motion. The important derivatives were identified for both longitudinal and lateral-directional motion. Author (TAB)

N67-17744# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOVIET HELICOPTER CONSTRUCTION
A. M. Izakson 21 Nov. 1966 174 p refs Transl. into ENGLISH from the book "Sovetskoye Vertoleto-Stroyeniye" Moscow, Izd. "Mashinostroyeniye", 1964 p 1-163, 178-183, 196-209
(FTD-MT-65-90; TT-67-60186; AD-643594) CFSTI: HC $3.00/MF $0.65

The book concerns the history of helicopter design and construction in general and Soviet helicopters in particular, divided into a number of stages. During the description of each stage a short survey of the stage of foreign helicopter construction is also given. Also, all Soviet experiments on autogyros are described. Classifications of presently used helicopters and a short survey of the basic technical problems of contemporary helicoptar construction are given in the book. Some biographical data of the Soviet helicopter pioneers are given. The author is one of the pioneers of Soviet helicopter design. TAB

N67-17747# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.

A SUMMARY OF SOME RECENT DEVELOPMENTS IN THE DESCRIPTION OF ATMOSPHERIC TURBULENCE USED FOR AIRCRAFT STRUCTURAL DESIGN Technical Report, 1 Feb.–1 May 1966

William Hugh Austin, Jr. Aug. 1966 31 p refs

(SEG-TR-66-45; AD-643774) CFSTI: HC $3.00/MF $0.65

In recent years, aircraft structures engineers have come to rely on power spectral density concepts in the description of atmospheric turbulence used in structures work. This is primarily due to a growing awareness that the spectral approach is far more realistic than the heretofore used discrete gust concept. Although there is a considerable difference of opinion among various investigators on the precise mathematical forms of relations used in the spectral approach, it appears that the approach can be used with confidence on most present day aircraft as long as it is applied in a consistent fashion. Using spectral techniques, it is possible to convert aircraf, gust acceleration statistics into a form that can be used by engineers as an accurate description of atmospheric turbulence for various classes of aircraft. These techniques have been applied to a very large sample of B-52 gust acceleration statistics taken during cruise operations to demonstrate the procedure. It is noted that, even if the mathematical forms of relations used in the spectral procedure are changed, changes in the description of atmospheric turbulence can be made rather easily. TAB

N67-17857# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PARACHUTE

Ye. F. Yefremov, G. V. Petkus, and K. S. Morozov 9 Sep. 1966 5 p Transl. into ENGLISH from Russian Patent no. 171274 (Appl. no. 460905/40-23, 4 Jan. 1965) p 1–2

(FTD-HT-66-104; AD-643703) CFSTI: HC $3.00/MF $0.65

The object of the invention is a parachute with a canopy in the form of a circular belt. To increase its coefficient of lift and its stability, it is equipped with a small hemispherical canopy, the shroud lines of which go through an eye ring that is fastened to the central shroud line and the external rim is connected with the internal edge by four mutually perpendicular shroud lines. Author (TAB)

N67-17872*# National Aeronautics and Space Administration, Washington, D. C.

PRELIMINARY INVESTIGATIONS CONCERNING THE HYPERSONIC GLIDER

Ph. Poisson-Quinton, R. Ceresuela, and G. Bernet Jan. 1963 35 p Transl. into ENGLISH from French Presented at the 5th European Aeron. Congr., Venice, 12–16 Sep. 1962

(NASA-TT-F-8326) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Results are presented of configuration studies. The lift of a hypersonic glider is superior to a ballistic object only when its fineness exceeds 2, but blunted shapes are required to limit the aerodynamic heating. A search was therfore made for compromise configurations within a range of Mach numbers from 20 to 5. Effects of wing thickness and leading edge sweep were investigated using a basic glider configuration (75° delta wing, fuselage above the wing); the Mach 10 lift and drag were measured for large incidences up to 90°. Longitudinal stability experiments showed that a better nose-up torque can be obtained by adapting the plane of the wing rather than by turning downward the surfaces controlling the leading edge. Investigations of the aerodynamic heating on the leading edge of the sweptback wing at Mach 10 in a hot hypersonic jetstream indicated that the flow at the nose end of the leading edge decreases linearly as the sweep increases. K.W.

N67-18117# Aeronautical Research Council (Gt. Brit.)

NORMAL ACCELERATIONS MEASURED IN THE COCKPIT AND AT THE C. G. OF A JET TRANSPORT AEROPLANE DURING FLIGHT THROUGH ROUGH AIR

J. Burnham London, HMSO, 1966 14 p refs Supersedes RAE-TR-64080; ARC-26795; See X65-14097

(ARC-CP-867; RAE-TR-64080; ARC-26795; AD-803304) CFSTI: HC $3.00/MF $0.65

Normal accelerations covering frequency range between 0 and 10 cps have been measured in the cockpit and at the C.G. of the Comet 3B aircraft during flight at 230 knots through rough air at an altitude of 2000 ft. The rms acceleration in the cockpit was found to be about 15% less than that at the C.G. The reasons for this are investigated. TAB

N67-18150*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

ROLLING STABILITY DERIVATIVES OF A VARIABLE SWEEP TACTICAL FIGHTER MODEL AT SUBSONIC AND TRANSONIC SPEEDS

William P. Henderson, W. Pelham Phillips, and Thomas G. Gainer Washington, NASA, Feb. 1967 57 p refs

(NASA-TN-D-3845) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation was made in the high-speed 7- by 10-foot tunnel to determine the rolling stability derivatives. The study was made at Mach numbers from 0.40 to 1.20 and at angles of attack from −5° to 20°. The test Reynolds number per foot (per 30.48 cm) varied from 2.45×10^6 to 4.15×10^6. The results indicate that at low angles of attack the wing-fuselage combination exhibited large reductions in the damping-in-roll derivative and slight decreases in the yawing moment due to rolling velocity as the wing sweep was increased from 20° to 72.5°. As the angle of attack for the configuration with the wing swept back 20° was increased, the damping in roll was considerably reduced. However, for the configuration with the wings swept back 72.5°, the damping in roll increased for angles of attack from 0° up to about 8°; above this angle-of-attack range, reductions occurred. For the configuration without the wings, the horizontal and vertical tails provided an increment in the damping-in-roll derivative at low angles of attack of about −0.04. With the addition of the wings at either 20° or 72.5° of sweep, this increment was reduced by more than one-half. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-16723*# David Sarnoff Research Center, Princeton, N. J. Astro Electronics Applied Research Lab.
THIN FILM GaAs PHOTOVOLTAIC SOLAR ENERGY CELLS
P. A. Crossley, R. B. Gill, P. Vohl, and M. Wolf 17 Nov. 1966 34 p refs
(Contract NAS3-8510)
(NASA-CR-81314) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The reproducibility of the fabrication process for cells of Al/InAs/GaAs/$Cu_{1.8}Se$ structure has been improved so that high yields of operating cells have been obtained. This improvement has resulted from stabilization of the operation of the GaAs film growth equipment by greater control of the hydrogen supply to the furnace. A further contribution has been the use of optical transmission monitoring of the flash evaporation process for the $Cu_{1.8}Se$ film formation. Equipment has been developed for the growth of 10-cm^2-area GaAs films, but problems of uniformity have been encountered with these films. Other work reported includes the investigation of two post-fabrication etch treatments to improve cell stability, and an evaluation of platinum as a barrier-forming material. Author

N67-16729*# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
A PROGRAM OF RESEARCH AND DEVELOPMENT OF LOW INPUT VOLTAGE CONVERSION AND REGULATION Quarterly Report, 15 Dec. 1965–14 Mar. 1966
John T. Lingle and Kenneth J. Jenson 14 Mar. 1966 55 p
(Contract NAS5-9212)
(NASA-CR-81305; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Progress is reported from research on Low Input Voltage Conversion and Regulation (LIVCR) systems for use with energy conversion sources in satellites. Primary effort was directed towards the synchronization of three redundant LIVCs and the fabrication of the LIVCRs for the triredundant configuration. Consideration was also given to load sharing in redundant LIVCs and in redundant regulators in conjunction with the general power configuration evaluation. The synchronization circuit developed maintains an 120 degree phase separation between the current feedback power oscillators and operates very well even after failures occur in respective redundant LIVC branches. It is concluded that the 3-phase circuit is well suited to the redundant LIVC application. A.G.O.

N67-16730*# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
A PROGRAM OF RESEARCH AND DEVELOPMENT OF LOW INPUT VOLTAGE CONVERSION AND REGULATION Final Report, 14 Jun. 1965–14 Jul. 1966
John T. Lingle and Kenneth J. Jenson 14 Jul. 1966 82 p
(Contract NAS5-9212)
(NASA-CR-81318) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The development of techniques and hardware for a Low Input Voltage Converter-Regulator (LIVCR) system is summarized. A redundancy philosophy for the regulators is presented, and manual switching circuits is to implement the philosophy are described. Reliability test results are reported for various LIVCR components, and equations written for estimating the reliability of LIVCR systems are given. Investigations on high speed switching, LIVC synchronization, LIVC load sharing, regulator redundancy, and model performance are also reviewed. It is felt that the model which was developed represents a valid approach for the design of an efficient, highly reliable LIVCR for future aerospace applications. A.G.O.

N67-16861# Library of Congress, Washington, D. C. Aerospace Technology Div.
PURE FLUID DEVICES Surveys of Foreign Scientific and Technical Literature
29 Aug. 1966 278 p refs Compilation of abstracts
(ATD-66-107)

Reviews of Soviet developments in pneumatic devices are presented. For individual titles see N67-16862–N67-16883.

N67-16862# Library of Congress, Washington, D. C. Aerospace Technology Div.
A METHOD FOR CALCULATION OF SELF-OSCILLATIONS IN PNEUMATIC REGULATORS
A. A. Abdullayev and E. M. Nadzhafov *In its* Pure Fluid Devices 29 Aug. 1966 p 56–70 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 3, 1956 p 195–210 (See N67-16861 07-03)

The self-oscillations which arise in the internal circuit of regulators widely used in the automation of continuous technological processes are investigated. A method is developed which permits the calculation of these oscillations by means of the harmonic balance principle. Simplified computing analogs are suggested, and the calculation performance of each analog is evaluated. A.G.O.

N67-16863# Library of Congress, Washington, D. C. Aerospace Technology Div.
STUDY OF MEMBRANE DEFLECTIONS IN AUTOMATIC MANOMETERS
V. I. Bakhtin *In its* Pure Fluid Devices 29 Aug. 1966 p 71–73 refs Transl. into ENGLISH from Priborostroenie (Moscow), no. 1, 1959 p 20–22 (See N67-16861 07-03)

The automatic compensation of gas pressure on a membrane which makes it possible to change measurement of a physical quantity into measurement of an electric current is investigated. Consideration is given to the analytical determination of a function which shows how the output signal depends upon the gas pressure in the theoretical operation of an automatic manometer. Study results show that the instrument and its readings are not dependent upon the properties of the membrane, the role of which has been limited to that of a separator. A.G.O.

N67-16864# Library of Congress, Washington, D. C. Aerospace Technology Div.
PNEUMATIC SWITCHING CIRCUITS
T. K. Berends and A. A. Tal' *In its* Pure Fluid Devices 29 Aug. 1966 p 74–84 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 11, 1959 p 1483–1495 (See N67-16861 07-03)

Descriptions are given of apparatus used in constructing pneumatic switching circuits. Methods are demonstrated of realizing by pneumatic means the elementary logical functions and a one-cycle delay function. It is also shown that any finite automation can be constructed by means of pneumoautomata. The circuits are given for several pneumatic devices which implement analog-to-digital conversions. Examples are given of the application of pneumatic switching circuits in industrial pneumoautomatic devices. Author

N67-16865# Library of Congress, Washington, D. C. Aerospace Technology Div.
PNEUMATIC RATIO CONTROLLERS WITHOUT MECHANICAL DIVIDERS
G. T. Berezovets *In its* Pure Fluid Devices 29 Aug. 1966 p 85–91 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 5, 1956 p 460–466 (See N67-16861 07-03)

The paper describes two types of ratio controllers which do not contain mechanical dividers. The first type of controller is designed to keep the specified ratio constant; the second type of controller allows automatic correction of the specified ratio according to a third parameter, or allows remote control of the magnitude of the ratio. Author

N67-16866# Library of Congress, Washington, D. C. Aerospace Technology Div.

INVESTIGATION OF THE INFLUENCE OF VARIATIONS IN MEMBRANE CURVATURE AND EFFECTIVE SURFACE ON THE OPERATION OF PNEUMATIC DEVICES CONSTRUCTED ON THE PRINCIPLE OF FORCE COMPENSATION

Ching-Lieng Chou *In its* Pure Fluid Devices 29 Aug. 1966 p 92–101 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 6, 1959 p 773–783 (See N67-16861 07-03)

An investigation is made of the effect of deviations in effective surface and curvature of rubber-tissue membranes on the quality of operation of pneumatic regulating devices constructed on the principle of force compensation. It is shown that deviations of membranes' effective surfaces from their nominal values can lead to a disruption of regulator adjustment and to the appearance, in isodrome regulations, of residual irregularities. Author

N67-16867# Library of Congress, Washington, D. C. Aerospace Technology Div.

COMPUTATION OF THE STATIC CHARACTERISTIC OF A PNEUMATIC RELAY

V. N. Dmitriev *In its* Pure Fluid Devices 29 Aug. 1966 p 102–116 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 9, 1956 p 761–774 (See N67-16861 07-03)

The paper examines a method for plotting the static characteristics of a pneumatic relay while taking into account the variability of the consumption coefficients of the restrictor elements. Author

N67-16868# Library of Congress, Washington, D. C. Aerospace Technology Div.

IMPROVEMENT OF THE STATIC CHARACTERISTIC OF A PNEUMATIC RELAY BY MEANS OF FLOW RESTRICTORS OF CONSTANT PRESSURE DROP

V. N. Dmitriev *In its* Pure Fluid Devices 29 Aug. 1966 p 117–129 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 8, 1957 p 689–701 (See N67-16861 07-03)

The possibilities for improvement of the static characteristic of a pneumatic relay by installation of flow restrictors of constant pressure drop are examined. The equations for static characteristics of such relays are derived, and the results of experimental investigations are given. Author

N67-16869# Library of Congress, Washington, D. C. Aerospace Technology Div.

CALCULATION OF TIME CHARACTERISTICS OF PNEUMATIC FLOW CHAMBERS

V. N. Dmitriev and V. I. Chernyshev *In its* Pure Fluid Devices 29 Aug. 1966 p 130–138 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 12, 1958 p 1118–1125 (See N67-16861 07-03)

Nonlinear differential equations of pressure variations in a pneumatic flow chamber are integrated with the assumption that any of the input quantities are subject to step variations. Examples of time characteristics calculations are given and these results are compared with characteristics obtained experimentally. Author

N67-16870# Library of Congress, Washington, D. C. Aerospace Technology Div.

GRAPHICOANALYTIC METHOD OF COMPUTING STEADY-STATE SPEED OF PNEUMATIC DRIVES

V. N. Dmitriev and V. I. Chernyshev *In its* Pure Fluid Devices 29 Aug.1966 p 139–145 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 10, 1959 p 1366–1373 (See N67-16861 07-03)

A method is considered for computing the steady-state motion of a pneumatic piston executive mechanism. A comparison is given of the computer and the experimental characteristics of such a mechanism. Author

N67-16871# Library of Congress, Washington, D. C. Aerospace Technology Div.

THE FORCE ACTION OF A JET UPON A VANE IN PNEUMATIC AND HYDRAULIC CONTROL ELEMENTS OF THE NOZZLE-VANE TYPE

V. N. Dmitriev and A. G. Shashkov *In its* Pure Fluid Devices 29 Aug. 1966 p 146–156 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 6, 1956 p 559–569 (See N67-16861 07-03)

The paper provides the results of the theoretical and experimental investigation of the force action of a jet upon a vane in pneumatic and hydraulic control elements of the nozzle-vane type. The formula is derived for determining the force which acts upon the vane. The experimental investigation is described and the effect of various parameters on the magnitude of the force is described. An experimental verification is made of the theoretically obtained function. Author

N67-16872# Library of Congress, Washington, D. C. Aerospace Technology Div.

DETERMINATION OF THE EXTERNAL CHARACTERISTIC AND CALCULATION OF PARAMETERS OF A HYDRAULIC COMPENSATION REGULATING UNIT

V. M. Dvoretskii *In its* Pure Fluid Devices 29 Aug. 1966 p 157–161 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 11, 1958 p 1010–1015 (See N67-16861 07-03)

An expression for the external characteristic of a hydraulic compensation regulating unit is determined. Calculation of the main parameters of the unit is proposed. Some experimental results are described. Author

N67-16873# Library of Congress, Washington, D. C. Aerospace Technology Div.

POLARIZED-RELAY VIBRATION CONTROL BLOCK FOR PNEUMATIC DRIVES

N. S. Gorskaya and B. I. Myzin *In its* Pure Fluid Devices 29 Aug. 1966 p 163–168 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 7, 1959 p 992–998 (See N67-16861 07-03)

A polarized-relay vibration control block designed to operate with pneumatic drives is considered. The basic requirements imposed on the vibration control blocks of pneumatic drives, at whose outputs autooscillations are inadmissible, are formulated, the characteristics of the block are given, as well as oscillograms of the transient responses in the individual portions of the control block and the results of testing it in a complete scheme of a servomechanism in conjunction with a pneumatic drive. Author

N67-16874# Library of Congress, Washington, D. C. Aerospace Technology Div.

A UNIVERSAL PNEUMATIC MULTIPLIER-DIVIDER AND A SQUARE-ROOT EXTRACTOR

Iu. I. Ivlichev and E. M. Nadzhafov *In its* Pure Fluid Devices 29 Aug. 1966 p 169–180 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 11, 1958 p 997–1009 (See N67-16861 07-03)

Block schematics are given for a universal pneumatic multiplier-divider and a square-root extractor. The equations describing the operation of these devices are derived and estimates of the accuracy of these devices are given. The results of experimental investigations are also cited. Author

N67-16875# Library of Congress, Washington, D.C. Aerospace Technology Div.

ON INCREASING THE PRESSURE OF THE WORKING AGENT IN JET AMPLIFIERS

B. D. Kosharskii *In its* Pure Fluid Devices 29 Aug. 1966 p 181–185 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 7, 1959 p 978–982 (See N67-16861 07-03)

The computed values of the parameters characterizing the operation of an amplifier with a vertical jet pipe are analyzed for various input pressures. To increase the input pressure a way must be determined of changing the construction of the valve device since, with increased pressure, the jet reaction at the valve openings is sharply increased, as is the inertial axial force, allowing autooscillation to develop in the valve itself. There must also be taken into account the effect of obliteration, which lowers the sensitivity of the valve device when the pressure of the working agent is raised. Design parameters are chosen for a two-stage amplifier operating with increased pressures of the working agent, taking into account the load on the bearings of the jet pipe which determines the sensitivity of the entire device. A.G.O.

N67-16876# Library of Congress, Washington, D. C. Aerospace Technology Div.

ELECTROPNEUMATIC TRANSDUCERS OF THE IAT AN SSSR

Yu. V. Krementulo *In its* Pure Fluid Devices 29 Aug. 1966 p 186–193 Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 2, 1959 p 211–219 (See N67-16861 07-03)

Two types of tranducers are described which have an electrical parameter as their input and compressed air pressure at their output. Consideration is given to the principles of operation and applications of these devices. It is noted that operating experience has shown that transducers of this type can be successfully used in automatic control and tracking systems. A.G.O.

N67-16877# Library of Congress, Washington, D. C. Aerospace Technology Div.

PNEUMATIC ANALOGUE COMPUTER

N. D. Lanin *In its* Pure Fluid Devices 29 Aug. 1966 p 194–196 Transl. into ENGLISH from Priborostroenie (Moscow), no. 7, 1959 p 3–6 (See N67-16861 07-03)

A computer designed to solve linear differential equations with constant coefficients, as well as to simulate automatic control systems with natural and transposed time scales is described. Schematic diagrams are presented which show the basic elements of the computer, the summator and the integrator. Results from tests on a computer model to investigate integrator linearity are also discussed. A.G.O.

N67-16878# Library of Congress, Washington, D. C. Aerospace Technology Div.

DESIGN OF PNEUMATIC DIFFERENTIAL TRANSMITTERS

M. Kh. Lantsman and M. S. Slobodkin *In its* Pure Fluid Devices 29 Aug. 1966 p 197–199 refs Transl. into ENGLISH from Priborostroenie (Moscow), no. 10, 1959 p 9–11 (See N67-16861 07-03)

The operating principles of the transmitter are described, and the balanced state of the dynamic system is analyzed. Consideration is given to the main errors of this type of device which are introduced by the systematic nonlinearity of the device transmitting ratios, by the friction forces of the beam system, and by changes of the ambient temperature. It is noted that the elasticity of the components of the dynamic system has some influence on the accuracy of higher precision transmitters. However, in practice, the transmitters with non-stiff dynamic systems and correctly designed beams are accurate and the corrections, based on the evaluations in this study are negligible. A.G.O.

N67-16879# Library of Congress, Washington, D. C. Aerospace Technology Div.

A PNEUMATIC EXTREMUM REGULATOR

Iu. I. Ostrovskii *In its* Pure Fluid Devices 29 Aug. 1966 p 200–212 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 11, 1957 p 1045–1051 (See N67-16861 07-03)

The design of a pneumatic extremum regulator consisting of four main units: memory, comparator, step valve, and constant rate, is described. The operational sequence is shown, and it is emphasized that the regulator operates by "remembering" the maximum. Laboratory test results on the regulator are also given. A.G.O.

N67-16880# Library of Congress, Washington, D. C. Aerospace Technology Div.

MICRO-FLOW DIAPHRAGM REGULATING VALVES

M. S. Slobodkin and G. F. Sokolin *In its* Pure Fluid Devices 29 Aug. 1966 p 213–216 Transl. into ENGLISH from Priborostroenie (Moscow), no. 7, 1959 p 14–16 (See N67-16861 07-03)

Standard specifications are considered for diaphragm micro-flow valves to be used at various working pressures, and the design of valves made from steel and stainless steel is evaluated. Operating mechanisms and principles are analyzed in order to obtain optimum design dimensions. Schematic diagrams of diaphragm regulating valve designs are also presented. A.G.O.

N67-16882# Library of Congress, Washington, D. C. Aerospace Technology Div.

SOME ASPECTS OF PNEUMATIC EXTREMUM CONTROLLER DESIGN

L. A. Zalmanzon *In its* Pure Fluid Devices 29 Aug. 1966 p 222–226 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 1, 1957 p 87–91 (See N67-16861 07-03)

Conditions are indicated under which it is desirable to supplement controllers of normal type by automatic adjustment to the maximum or minimum of some quantity dependent on the controlled parameter. One possible way of doing this, by means of pneumatic devices, is considered; automatic adjustment is performed by a pneumatic device consisting of a pneumatic divider coupled to a system of parallel and intersecting pipes, together with certain other units. Author

N67-16883# Library of Congress, Washington, D. C. Aerospace Technology Div.

INVESTIGATION OF THE CHARACTERISTICS OF PNEUMATIC JET ELEMENTS

L. A. Zalmanzon and A. I. Semikova *In its* Pure Fluid Devices 29 Aug. 1966 p 227–244 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 4, 1959 p 447–467 (See N67-16861 07-03)

The article deals with an investigation of pneumatic jet elements, the operation of which is based on the utilization of the characteristics of pressure changes obtained when the impact tube is moved through different sections of the jet flowing from a nozzle. Examples are given of the possible applications of such elements in pneumatic devices. Author

N67-16902*# General Electric Co., Philadelphia, Pa. Spacecraft Dept.

FLIGHT-PROVEN MECHANISMS ON THE NIMBUS WEATHER SATELLITE

S. Charp and S. Drabek *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 1–25 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

Design details and performance characteristics of the mechanical devices and subsystems of the Nimbus satellite are discussed. These are categorized as (1) continuous operation

sealed components comprising infrared horizon scanners, yaw gyro reference package, momentum generators, and pneumatic system; (2) single operation unsealed simple components consisting of a booster attachment, separation springs, paddle unfold system, and paddle support; (3) single operation (paddle damper) sealed components; (4) repeated operations unsealed complex components such as the solar array drive; (5) repeated operations unsealed simple components covering temperature controllers, shaft bearings, shutter position indicators, and slip rings; and (6) electromechanical devices including high and medium resolution infrared radiometers, and the advanced vidicon camera system. It was concluded that space environment does not severely limit design. Likewise, solar ultraviolet and low energy proton and electron bombardment has not influenced design except with respect to the thermal coatings used on the spacecraft surfaces. M.G.J.

N67-16910*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT HYDRAULIC TIMERS
Harland D. Trimble *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 101–108 (See N67-16901 07-30) CFSTI: HC $3.00/MF$0.65
(Contract NAS7-100)

The functional commands which the Ranger and Mariner hydraulic timers were required to perform are listed, and the normal actuation times and tolerances for spacecraft hydraulic timers are tabulated. The design principles are outlined, and summary information is presented on the experiments conducted to determine the type of oil, the temperature dependence, mechanical and electrical design modifications, and the problems encountered during qualification testing. It is pointed out that no flight anomalies were detected in any of the Ranger or Mariner timers. M.G.J.

N67-16911*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOLAR CELL GRAVITY-STABILIZATION BOOMS
Bodwell D. Osborne *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 109–121 (See N67-16901 07-30) CFSTI: HC $3.00/MF$0.65

This paper presents a scheme for combining a spacecraft gravity-stabilization boom with a solar-cell array, examines some of the relevant problems, and proposes a method for testing the mechanism in an underwater environment, where zero-gravity conditions can be approximated. Author

N67-16921*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SIMPLIFIED SPACE MECHANISMS USING SUBLIMING SOLIDS
Howard M. Kindsvater *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 239–249 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF$0.65

The subliming solids technique can sometimes be utilized to solve difficult spacecraft design problems. In this connection, comparison is made of the characteristics and the suitability of subliming-solid and conventional aerospace devices in 17 spacecraft operations requiring four classes of mechanisms. To provide meaningful conclusions, a matrix methodology is utilized. Author

N67-16925*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXPLOSIVELY ACTUATED (PYROMECHANICAL) DEVICES FOR SPACECRAFT APPLICATIONS
A. G. Benedict *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 285–296 (See N67-16901 07-30) CFSTI: HC $3.00/MF$0.65

General guidelines are offered for achieving maximum economy, schedule adherence, and reliability in the application, design, and testing of pyromechanical devices. It is emphasized that the single shot characteristic of the pyromechanical device is an important design consideration because it precludes proof testing of flight hardware. Particular attention is given to the analytic type of devices, which use propellant type explosives for development of a high pressure gas expanding adiabatically in a piston and cylinder (heat engine) arrangement. Several aspects which must be considered in the design are listed, and test programs are proposed. M.G.J.

N67-16927*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AN EXTENDIBLE STRUCTURE FOR SOLAR ELECTRIC POWER IN SPACE
D. E. Lindberg *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 311–320 (See N67-16901 07-30) CFSTI: HC $3.00/MF$0.65

An extendible structure used to angularly position four planar surfaces of solar-sensitive cells for a spacecraft electric power system is described. It includes the system requirements, the type of mechanisms used, and the ascent support structure. Since the assembly cannot be operated in a 1-g environment without support, a description of the equipment used for ground test is also included. Author

N67-16938# IIT Research Inst., Chicago, Ill.
STATIC ELECTRIC POWER INVERSION USING SEMICONDUCTOR DEVICES Final Report
Harlan G. Hamre and Oleh M. Kuritza Port Hueneme, Calif., Naval Civil Eng. Lab., Sep. 1966 67 p refs
(Contract NBy-62189)
(IITRI-CR-67.009; AD-640968) CFSTI: HC $3.00/MF$0.65

Results of a study of static electric power inversion techniques using semiconductor devices are given, including recommendations that bridge-type inverters, employing impulse commutation, sinusoidal wave form synthesis using stepped-wave techniques, and output voltage control within the inverter by use of pulse-width methods, are most suitable for use in the design of a family of inverters in the power range from 10 KW to 600 KW. Additional requirements of transient stability, frequency control, reliability, electromagnetic compatibility, and system costs are considered. Comparative analysis of various solid state devices and inverter techniques, and their advantages and disadvantages are discussed. Present trends in the development of static power inverter equipment are considered and future trends are anticipated, where possible. Recommendations are given to indicate areas where additional investigation is needed. Author (TAB)

N67-16967# Air Force Flight Test Center, Edwards AFB, Calif. Flight Research Div.
PERFORMANCE ANALYSIS OF AIRCRAFT SUBSYSTEMS BASED ON AUTOMATIC AIRBORNE DATA ACQUISITION
Donald M. Caldwell, Jr. and Lee Winograd *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 45 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF$0.65

Measurements were made of parameters of subsystems' operation on the C-141A aircraft in order to analyze and predict degraded performance, malfunctions and failures. A method of approach is described for analyzing subsystem functions and correlating such measurements to reveal trends in the electrical and mechanical condition of subsystems and their major components. Principles are presented for identifying characteristic performance parameters for three functional classes of subsystems and for selecting measureable variables of subsystem operating state, control inputs and environmental stresses. The feasibility of measuring and recording the variables with sufficient accuracy for detection of performance trends is discussed. Also included is a discussion of statistical measures of regression and correlation of flight data giving information on present and predicted subsystem health and subsystem interactions. Author

N67-16968# Air Force Systems Command, Los Angeles, Calif. Space Systems Div.

AN ANALYSIS OF RADIOISOTOPE DYNAMIC POWER SYSTEMS FOR FUTURE MILITARY SPACE PROGRAMS

David Kauffman and John T. Piker *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 28 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

Four possible energy sources are examined for long duration space missions: chemical, solar, nuclear reactor, and radioisotope. Chemical and nuclear reactor sources are eliminated because of excessive weight. Radioisotope energy sources are selected over solar energy. Thermoelectric, thermionic and dynamic energy conversion are compared. Dynamic conversion is selected based on its overall greater potential. A study is presented comparing five candidate dynamic energy conversion systems: the Rankine cycle using mercury, water, and organic working fluids; the Brayton cycle and the Stirling cycle. The thermodynamics of each cycle are presented and performance characteristics are given parametrically. Each cycle is examined in light of other factors, including flexibility, launch-pad and on-orbit maintainability, simplicity, weight, reliability, development status, and development problem areas. Costs are considered. The Brayton cycle is selected as optimum for this class of missions. Author

N67-17000# Eagle-Picher Co., Joplin, Mo. Couples Dept.

INVESTIGATIONS LEADING TO THE DESIGN AND DEVELOPMENT OF MAGNESIUM/MAGNESIUM PERCHLORATE BATTERIES Quarterly Report, 1 May–31 Jul. 1966

Francis A. Bartley Ft. Monmouth, N. J., Army Electron. Command, Nov. 1966 38 p

(Contract DA-28-043-AMC-01763(E))

(ECOM-01763-s; QR-3; AD-643320) CFSTI: HC $3.00/MF $0.65

This report describes the significant accomplishments made on the research and development of magnesium/magnesium perchlorate batteries. Two factorial design experiments were run to determine the most practical grid for the manganese dioxide depolarizer. Data concerning the N/5 cell type is presented in detail. The new N/5 cell design is introduced to the AN/PRC-62 application. Other variables such as type carbon, per cent carbon and type blend were investigated and their effect on cell performance is discussed. Author (TAB)

N67-17035# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Space and Defense Sciences Dept.

A HYDROGEN GENERATOR Final Technical Report, 30 Jun. 1965–30 Jun. 1966

Sep. 1966 46 p

(Contract DA-44-009-AMC-1098(T))

(ACSDS-096640, Vol.-1; AD-642140) CFSTI: HC $3.00/MF $0.65

A report is made on the development of a generator to produce 140 SCFH of ultra-high purity hydrogen by the thermocatalytic dissociation of ammonia and subsequent diffusion of the produce for delivery at 3 psig. A discussion of the subsystems and components is presented. The system, as delivered, weighs 130 pounds, occupies 3.5 cubic feet, delivers from zero to 140 SCFH of hydrogen with a change-in-rate response time of less than 30 seconds, and operates at rated output with 72 percent thermal efficiency. Author (TAB)

N67-17074# Sandia Corp., Albuquerque, N. Mex.

AN APPLICATION OF REENTRY THERMOCHEMISTRY TO POWER GENERATION

K. J. Touryan and M. M. Sluyter Sep. 1966 35 p refs

(Contract AT(29-1)-789)

(SC-RR-66-358) CFSTI: HC $3.00/MF $0.65

Theoretical and experimental analyses are presented which describe the operation and characteristics of an aerodynamic source of power from typical reentry vehicles entering the earth's atmosphere on ballistic and superorbital trajectories. Author (NSA)

N67-17120* Serendipity Associates, Chatsworth, Calif.

A STUDY OF THE CONCEPTUAL DESIGN OF A REMOTE CONTROL STATION Final Report

W. Straly and K. Insba Sep. 1966 156 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951313)

(NASA-CR-81523; TR-[illegible] CSCL 05H

System requirements and design concepts are detailed for a remote control station (RCS) in a real time command/control loop during future unmanned spaceflight operations. Control of the spacecraft can be accomplished from an integrated mission-independent control complex, and an organizational structure is included that provides a framework for assigning the physical means of control to provide an effective man-machine system. The RCS functional configuration assumes that the reliability of command sequences as generated, or modified, will be sufficiently less than unity so that check functions will be required. A digital simulation model is considered best for obtaining the necessary quantitative data, which will permit a more detailed design of the RCS system. Some of the concepts required by the system engineering approach used in the study include the state-change, system hierarchy, system effectiveness, analysis and synthesis, functions as building blocks, requirements preceding means, and requirements-oriented design pyramid. M.W.R.

N67-17242# Burgess Battery Co., Freeport, Ill.

DEVELOPMENT OF MAGNESIUM WAFER CELLS Quarterly Technical Progress Report, 1 May–31 Jul. 1966

Timothy S. Hungate Oct. 1966 34 p

(Contract DA-28043-AMC-02135(E))

(QR-1; Rept.-1; ECOM-02135-1; AD-641660) CFSTI: HC $3.00/MF $0.65

The purpose of this development contract is to design a practical magnesium wafer battery which performs satisfactorily after storage for various periods at ambient temperatures up to 160F. The initial phase of development includes the design of a cell and the resulting battery systems which perform reliably after being subjected to storage at 70F and 113F. Batteries are being constructed using both eight and nine cells in a series. Discharge results indicate it is possible to reproducibly build nine cell batteries and predict their performance after storage at 70F and 113F. Capacity results after storage at 130F are erratic and, for all practical purposes, there is no performance after storage at 160F. Author (TAB)

N67-17250# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center.

HIGH ENERGY SYSTEM (ORGANIC ELECTROLYTE) Final Report, 15 Jun. 1965–14 Jun. 1966

D. P. Boden, H. R. Buhner, and V. J. Spera Sep. 1966 126 p refs

(Contract DA-28-043-AMC-01394(E))

(ECOM-01394-f; AD-8439709) CFSTI: HC $3.00/MF $0.65

The report describes a project to develop a system capable of delivering energy in excess of 200 w-hrs/lb of total battery weight. Screening tests at the beginning of the program indicated that the lithium/cupric fluoride system offered the best possibility of success. Electrolyte studies indicated that the most promising solvents were propylene carbonate, dimethyl carbonate and dimethyl sulphite which in conjunction with lithium perchlorate yielded electrolytes having adequate conductance and which were inert towards the electrode materials. Anode studies revealed that lithium electrodes prepared from commercially available foil could be discharged over a wide range of current densities yielding high coulombic efficiency without appreciable polarization. The most

encouraging techniques for cupric fluoride cathode fabrication were found to be a hot pressing method using polyethylene as a binder and a cold pressing method using paper floc as a binder. Multiplate assemblies were constructed containing nine electrodes and having a nominal capacity of 7 a.h. These were capable of being discharged in 1 F $LiClO_4$/propylene carbonate electrolyte at 2 ma/sq. cm. (250 ma) to yield 1 17 w-hrs/lb of total battery weight. Author (TAB)

N67-17296# Harry Diamond Labs., Washington, D. C.
FLUID CONTROL THEORY
Joseph M. Kirshner *In* Md. Univ. Aerospace Eng. 1966 Sep. 1966 p 46–49 (See N67-17293 07-34) CFSTI: HC $3.00/MF $0.65

Some of the conceptual difficulties present in fluid circuit theory are delineated, and problems involved in obtaining capacitances, resistances, and inertances as pure as their electronic counterparts are mentioned. In spite of these problem areas, it is pointed out that, when combined with experimental techniques, existing theory has resulted in analog devices that can add, subtract, differentiate, integrate, and to some extent, multiply and divide. It has also resulted in logic element circuits that are the equivalents of practically all the existing electronic logic circuits. L.E.W.

N67-17426# Sundstrand Corp., Rockford, Ill.
ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM Quarterly Progress Report No. 1, Feb. 15–Jun. 30, 1966
A. Warren Adam 28 Jul. 1966 62 p
(Contract AT(04-3)-651)
(SAN-651-1; AER-452) CFSTI: HC $3.00/MF $0.65

Biphenyl and biphenyl ether working fluids for an organic Rankine cycle power conversion system capable of long duration operation in space were investigated. A configuration for the test loops, including the pumping system, was designed. Preliminary design of the heat rejection system was completed. Specifications for the procurement, handling, and analysis of the working fluids have been prepared. NSA

N67-17581# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
HIGH-VOLTAGE PERFORMANCES OF ELECTROSTATIC SEPARATORS
P. Coet Mar. 1966 56 p refs Transl. into ENGLISH from CERN Rept. MPS/Int. MU-S-66-1
(NP-TR-1419)

A discussion is presented on the high-voltage performance of electrostatic separators, especially from the point of view of long-term use (several thousands of hours). The discussion is on separators with stainless-steel electrodes and oxide-coated aluminum cathodes. NSA

N67-17586# Atomics International, Canoga Park, Calif.
ANALYSIS OF SAFETY AND RELIEF VALVE INSTALLATIONS IN THE SCTI MAIN STEAM LINES
K. A. Bonyhady 10 May 1966 49 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11961) CFSTI: HC $3.00/MF $0.65

A vibration analysis was made of the safety and relief valve installations in the 4-in. main steam pipeline of the Sodium Components Test Installation (SCTI). During startup of the SCTI steam section, some safety valves showed undesirable vibrational behavior. This analysis was made to determine improvements which will correct the dynamic load problems encountered. The modifications recommended will permit keeping the plant down time to a minimum and will involve minimum labor and material costs. They will assure proper operation of the main steam line at the rated plant conditions. The following improvements are recommended: (1) move to high-pressure steam safety valves next to the steam generator steam outlet nozzles, (2) anchor two points of the main steam lines at the intermediate and at the low pressure section safety valves, (3) adjust hanger loads (affected by the above modifications) to agree with the detailed piping hangerload and thermal stress computations, and (4) add vibration dampeners (snubbers) to reduce the expected vibrations and resist the additional piping loads from the electromatic safety valve. Author (NSA)

N67-17598# Babcock and Wilcox Co., Barberton, Ohio. Boiler Div.
SODIUM-HEATED STEAM GENERATOR DEVELOPMENT Quarterly Progress Report, Apr.–Jun., 1966
19 Jul. 1966 25 p
(Contract AT(11-1)-1280)
(BAW-1280-39) CFSTI: HC $3.00/MF $0.65

The preliminary design of the Prototype Steam Generator was completed and the design report, BAW-1280-28, was distributed. The detail design and fabrication of the steam generator are discussed. Fabrication is 70% complete. The status of the carbon transfer and effect on material properties and preliminary control and instrumentation studies are outlined. NSA

N67-17623*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF SOLAR DIRECT-ENERGY CONVERSION SYSTEMS OPERATING BETWEEN 1.0 AND 0.1 ASTRONOMICAL UNIT
William J. Bifano and Larry R. Scudder Washington, NASA, Feb. 1967 32 p refs
(NASA-TN-D-3788) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Thermoelectric flat plates, thermionic systems, and uncooled silicon solar cells were compared as solar direct-energy conversion systems operating between 1.0 and 0.1 Astronomical Unit (AU). System specific weight and power output variation during flight were used as a basis of comparison by assuming that an output power of 200 watts was required at the design point. Tilting the thermoelectric and solar cell panels from 0° (panel normal to the incident radiation) to 80° was assumed to give solar flux control; however, no solar flux control was assumed for the thermionic systems. Silicon solar cells provide relatively constant output power from 1.0 to about 0.2 AU. Between 0.2 and 0.15 AU, the output power decreases rapidly to zero because of excessive cell operating temperatures. Solar thermoelectric flat plates and thermionic systems have potential application to within 0.1 AU or less; however, their electrical output power between 1.0 AU and the design point is initially low, increasing rapidly as the design point is approached. A hybrid system incorporating solar cells, and perhaps a thermoelectric flat plate, would provide a continuous power output from earth to 0.1 AU. Author

N67-17672# General Electric Co., Lynn, Mass.
HYDROCARBON–AIR FUEL CELLS Semiannual Technical Summary Report, 1 Jan.–30 Jun. 1966
30 Jun. 1966 244 p refs
(Contract DA-44-009-AMC-479(T); ARPA Order 247)
(SATSR-9; AD-640521) CFSTI: HC $3.00/MF $0.65

Detailed information is presented on a continuing research and development program to develop a direct hydrocarbon oxidation-air fuel cell technology. Current work included research on electrocatalysts, electrode structures, multi-component fuels, and investigations with alternate acid electrolytes. A number of alloys and non-alloys were studied as catalysts for the oxidation of hydrocarbon fuels. The development of supported electrocatalysts and related electrode structures is discussed. The behavior of fuel mixtures of saturated hydrocarbons and the effects of other components such as olefins, aromatics and naphthenes are reported.

Performance of hydrofluoric acid electrolyte operating with octane and its relationship to voltage cycling phenomena is discussed.
Author (TAB)

N67-17741# Marine Engineering Lab., Annapolis, Md.
RADIOISOTOPE STUDY OF THE ELECTROSORPTION OF METHANOL ON FUEL CELL ELECTRODES
R. E. Smith, H. B. Urbach, J. H. Harrison, and N. L. Hatfield
Nov. 1966 35 p refs
(MEL-363/66; AD-643529) CFSTI: HC$3.00/MF$0.65

Radiotracer techniques were used in the study of steady-state methanol adsorption as a function of potential on platinum electrodes in normal sulfuric acid solutions at room temperatures. A new window-electrode based on the use of gold-coated polyester film was developed in order to achieve high mechanical strength and counting efficiency. The observed steady-state coverage and the approach to the steady state were profoundly affected by the electrochemical pretreatment of the electrodes just prior to measurement. A bell-shaped curve of coverage versus potential was observed with preoxidized electrodes. The potential at which maximum adsorption occurred was 0.2 volt and was independent of methanol concentration, which deviates from results reported by previous investigators. With prereduced electrodes, the bell-shaped curve of coverage versus potential was distorted at low potentials. The time required for establishing steady-state coverage depended on the potential, being as long as 40 minutes in some cases.
Author (TAB)

N67-17822*# Procedyne Associates, Inc., New Brunswick, N. J.
COMMERCIAL POTENTIALS OF SEMIPERMEABLE MEMBRANES
Sidney B. Tuwiner, Ernest J. Henley, and H. Kenneth Staffin
Washington, NASA, 1967 47 p refs Sponsored by NASA
(NASA-SP-5061) GPO: HC$0.35; CFSTI: MF$0.65 CSCL 10C

A survey of research which focuses on advances in semipermeable membrane technology, and which has possible industrial applications; is reported. Presented are data on new techniques and principles; membrane applications in batteries; advances in material science; level control in batteries; fuel cells; and separation processes.
S.C.W.

N67-17828*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY EXPERIMENTAL EVALUATION OF A BRAYTON CYCLE TURBOCOMPRESSOR OPERATING ON GAS BEARINGS
Robert Y. Wong, Robert C. Evans, and Donald J. Spackman
Washington, NASA, 1966 39 p refs
(NASA-TM-X-52261) CFSTI: HC$3.00/MF$0.65 CSCL 10B

Results of a preliminary study into the mechanical and dynamic behavior of an exploratory Brayton cycle turbocompressor operating on gas bearings with a turbine inlet temperature up to 1000°F and speeds up to 38,500 rpm, are reported. Focused upon were packaging and operating problems resulting from the integration of gas bearings and turbomachinery in a single package. The following problem areas appeared to require attention: the apparent threshold of a critical speed at the design speed of 38,500 rpm; the possibility of insufficient thermal isolation between the turbine inlet and the internal parts; and the need for a means of obtaining a reliable indication of journal bearing load. Results indicate that modifications are needed to improve the thermal isolation between the turbine and the internal parts and to sense journal bearing load. Other modifications to be made include an increase in the preload of the journal bearings; a reduction in the spring rate of the loading diaphragms, and a means of pneumatically varying the journal bearing load.
S.C.W.

N67-17834*# Electro-Optical Systems, Inc., Pasadena.
POWER SUPPLIES USING HIGH FREQUENCY MODULES Final Report, Jun. 1965–Jan. 1967
Peter Ramirez, Jr. 1 Feb. 1967 172 p refs
(Contract NAS3-7926)
(NASA-CR-54714; EOS-6981-Final) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A program focusing on the design, development, and testing of three high frequency dc-dc converter modules; and the design of a control system which provides power distribution, control, switching, and the necessary regulation to operate ion engines in a space environment; is reported. Primary objectives of this research and development program were successfully attained. The three high frequency converter modules which were developed are small lightweight, efficient, and reliable. These modules can be used to construct power conditioning subsystems of any desired voltage and power level. The three converter modules were designed with overload and short circuit protection. All of the modules have successfully passed the prescribed performance tests. The packaging of the modules is unique in that they are designed for passive cooling. A control system was designed to provide power distribution, control switching, and the necessary regulation to operate ion engines in a space environment. The exclusive use of integrated circuits in the conversion of analog to digital information and in the detection of failed modules has made possible an extremely small and lightweight control system. Included is a brief discussion of missions for which the electric propulsion system appears attractive.
S.C.W.

N67-17851# Royal Aircraft Establishment, Farnborough (England).
SOME DESIGN PARAMETERS FOR LOW THRUST GAS JET CONTROL SYSTEMS
B. P. Day Feb. 1965 24 p refs
(RAE-TR-65014; AD-463207) CFSTI: HC$3.00/MF$0.65

Satellite jet control valve and nozzle discharge coefficients have been measured for air and propane. The pressure rise time in the valve to nozzle interspace has been measured and the results correlated with theoretically predicted values.
Author

N67-17854# Royal Aircraft Establishment, Farnborough (England).
A LIGHT-WEIGHT AIRCRAFT ELECTRIC POWER SUPPLY SYSTEM USING CHANGEOVER CONTACTORS
R. F. Sims and R. L. A. McKenzie Dec. 1965 17 p refs
(RAE-TR-65281; AD-482528) CFSTI: HC$3.00/MF$0.65

This report discusses a variation of a previously described two channel system employing changeover contactors. The total generator capacity for such a system may be reduced from twice to four thirds of the maximum aircraft load if, in the event of the failure of one channel, it is possible to discard one third of the load without affecting the safety of the aircraft or the success of its mission. The inessential part of the load is connected to a third bus-bar which is automatically disconnected if either generator has an overload in excess of 10%. The basic merits of the original scheme, simplicity and very short interruption times when faults occur, are not affected.
Author

N67-17867*# Philco Corp., Palo Alto, Calif. WDL Div.
THE FEASIBILITY OF A PROGRAMMED HEAT SHIELD FOR SOLAR CELL PERFORMANCE CONTROL
Michael W. Cobb, W. Scott Cummings, and John W. Fairbanks
15 Oct. 1965 150 p refs
(Contract NAS2-2564)
(NASA-CR-75707; WDL-TR-2623) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An analytical study has been performed on the feasibility of using a positionable despun thermal shield to control the temperature and power of a solar array used for spacecraft on-board

power during a 0.2 AU mission. The results of the study indicate that such a mission is feasible using body-mounted N/P silicon solar cells with blue–red full cell response bandwidth filters. A cylindrical spacecraft with a Pioneer configuration, spinning about its centerline at 60 rpm, was used in the study; the thermal shield consisted of two counter-rotating cylindrical surfaces with a radius only slightly larger than the spacecraft and rotating about the spacecraft spin axis. A minimum power output of 60 W was maintained; the maximum temperature of the solar array was 190°F at 0.2 AU. Author

N67-17884# Mechanical Technology, Inc., Latham, N.Y.
EXPERIMENTAL TEST AND EVALUATION OF A GAS-BEARING BRAYTON CYCLE TURBOCOMPRESSOR
J. S. Meacher 26 Aug. 1966 46 p refs
(Contract AT(30-1)-3237)
(MTI-66TR44; NYO-3237-6) CFSTI: HC$3.00/MF$0.65

The application of gas-lubricated bearings to closed-system gas-turbine machinery is described, a Brayton cycle gas generator (turbocompressor) utilizing self-acting gas bearings was designed, built, and is under test. Self-sustained closed-loop operation of the turbocompressor, using its own cycle gas as the bearing lubricant, was achieved. The turbocompressor has been successfully operated, with nitrogen, at 1300°F to 1400°F turbine inlet temperature, 24,600 rpm, a maximum equivalent output load of 37.6 KW(e) 15 and 20 psia compressor inlet pressure, under compressor surge conditions, and under transient conditions due to step changes in heater input power and compressor inlet temperature. Author (NSA)

N67-17963* Boeing Co., Seattle, Wash. Space Div.
LARGE AREA SOLAR ARRAY DESIGN, VOLUME II Quarterly Report, 19 Sep.–30 Dec. 1966
Jan. 1967 584 p Prepared for JPL
(Contracts NAS7-100; JPL-951653)
(NASA-CR-59386; QR-1, Vol. II; D2-113355-1, Vol. II) CFSTI: HC$3.00 CSCL 10A

Supporting data are presented on the basic design concept for the large area folding modular panel solar cell array and its evaluation. Appendices are included which consist of data charts, sketches, tables, formulas, and lists of information generated during the design studies. A.G.O.

N67-17968* Boeing Co., Seattle, Wash. Space Div.
LARGE AREA SOLAR ARRAY DESIGN, VOLUME I Quarterly Report, 19 Sep.–30 Dec. 1966
Jan. 1967 316 p refs Prepared for JPL
(Contract NAS7-100; JPL-951653)
(NASA-CR-81613; QR-1, Vol. I; D2-113355-1, Vol. I) CFSTI: HC$3.00 CSCL 10A

Progress is reported from the development, design, and testing of a 1250 square foot section of a folding modular panel solar cell array. The project includes investigation of the key technology problems associated with large, deployable high power arrays. The baseline preliminary design was evaluated and trade studies were conducted which resulted in recommended detail changes to the baseline. These changes rectify deficiencies, improve reliability, or result in estimated cost reductions. Program and test plans for the design, development, and verification testing of the panel assembly have been prepared, and a ground support equipment concept to support the program has been developed. A.G.O.

N67-17972*# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
STUDIES OF REACTION GEOMETRY IN OXIDATION AND REDUCTION OF THE ALKALINE SILVER ELECTRODE Quarterly Report
E. A. Butler and A. V. Blackham 10 Jan. 1967 24 p refs Prepared for JPL
(Contract NAS7-100; JPL-951554)
(NASA-CR-81609; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Equipotential maps for several electrode configurations were drawn and related to current distribution and electrode geometry. Potential differences and solution resistivities were plotted as functions of temperature. From these plots there appears to be an approximately linear relationship between potential difference and resistivity. An extension of surface area determinations which includes sintered silver electrodes was made. Data are presented which show the dependance of depth of penetration upon temperature. Author

N67-17973*# Westinghouse Electric Corp., Pittsburgh, Pa.
SEPARATOR DEVELOPMENT FOR A HEAT STERILIZABLE BATTERY Quarterly Report, 1 Oct.–31 Dec. 1966
A. Langer, R. G. Charles, and C. R. Ruffing 30 Dec. 1966 45 p Prepared for JPL
(Contract NAS7-100; JPL-951525)
(NASA-CR-81611; RR-66-986-BSEPA-R2; QR-2) CFSTI: HC $3.00/MF$0.65 CSCL 10C

Research was aimed at producing composite separators which would have a porous organic matrix or binder filled with inorganic substances having ion exchange properties to be used in silver–zinc batteries. A secondary effort to modify macroporous and microporous organic matrices by the attachment of chelating functional groups was also conducted. Progress is described from specific topics such as: membrane fabrication techniques, solvent and filler effects on membrane resistivity, sterilization exposure effects on membrane properties, resistance of compostie membranes to zinc dendrite penetration, incorporation of 8-hydroxyquinoline groups into epoxy resin matrices., and electrode rotation effects on zinc dendritic growth. A.G.O.

N67-17974* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
INVESTIGATION OF OPTIMIZATION OF ATTITUDE CONTROL SYSTEMS Quarterly Progress Report, 1 Oct.–31 Dec. 1966
J. Y. S. Luh 31 Dec. 1966 75 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950670)
(NASA-CR-81612) CFSTI: HC$3.00/MF$0.65 CSCL 09C

A computational scheme was developed in the theoretical study on the optimal control of the bounded phase-coordinate systems. The algorithm is based on the necessary conditions that the extremal control must satisfy any geometrical reasoning. The computational aspects of the antenna pointing problem were investigated with emphasis applied to the calculation of boundary value problems and multiple integrals. Programs in Fortran IV which were written to solve these problems are included. Consideration was also given to practical design problems in which the state vector of the system was not known. To estimate the state vector Kalman filtering techniques are applied to the control problem. A.G.O.

N67-17977*# Thermo Electron Engineering Corp., Waltham, Mass.
SOLAR THERMIONIC GENERATOR DEVELOPMENT Quarterly Report, 4 Sep.–30 Nov. 1966
Dec. 1966 45 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951263)
(NASA-CR-81646; TE-57-67; QR-4) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The fifth thermionic converter engineering model, T-205, was fabricated and tested. This converter had a design spacing of 4.2 mils instead of the spacing of 1.75 mils which had been used for model T-204. It was found that the arc-welded rhenium

tubing used for the fabrication of the all-rhenium support is often defective in the region of its seam weld. Consequently, efforts have been made to perform the seam welds of the tubes by electron-beam welding in the future. Further fabrication work involved the construction of pressure-bonded rhenium collectors and the lapping of emitter surfaces. A preliminary analysis of generator performance has been completed, which indicates that, of the several multi-converter generator configurations studied (namely, those with 10, 12, 14 and 16 converters), the largest generator is preferable in order to assure that the generator cavity will be large enough to handle the flux delivered by an 11.5-foot mirror at the test site. Author

N67-17984*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
HIGH-EFFICIENCY D-C TO D-C CONVERTER-REGULATORS
J. A. Bosco and J. K. Roberge Nov. 1966 32 p refs
(Grant NsG-234-61)
(NASA-CR-81663; ESL-R-288) CFSTI: HC $3.00/MF $0.65 CSCL 10A

D-c to d-c converter regulators described in this report use a variable-frequency control with flyback voltage conversion to obtain regulated output voltage and high efficiency over a wide range of output power. Pulsewidth is varied to maintain output power over a wide range of input voltages. Experimental circuits have shown conversion efficiences near 85 percent over a 100:1 range of output power. Flyback voltage conversion results in a small, lightweight package: a 300-watt supply weighs less than five pounds, without housing. Author

N67-17985*# Brown Univ., Providence, R. I. Div. of Engineering
PHOTOVOLTAIC EFFECT AND UTILIZATION OF CELLS Semiannual Report, Jul. 1–Dec. 31, 1966
J. J. Loferski, I. Kasai, and W. Giriat 31 Dec. 1966 26 p refs
(Grant NGR-40-002-026)
(NASA-CR-81664; SAR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The effects of 115 keV electron irradiation (this energy is below the threshold for bulk damage) on the surface recombination velocity s of n- and p-Si of various resistivities is determined from studies of changes in the photovoltaic short circuit current I_{sc} resulting from strongly absorbed light. The cells were special solar cells made on various resistivity base material. Both the "diffused" face and the "base" face were subjected to irradiation. It was found that as a result of irradiation, the value of s for n-Si generally decreases while that of p-Si generally increases. The changes can be as large as factors of 4, but are more commonly of the order of 10 to 20%. The recovery of the pre-irradiation state is also described and discussed. A new apparatus for conducting experiments in an organic vapor free vacuum is also described. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-16701* National Academy of Sciences–National Research Council, Washington, D.C.
IDEAS IN MODERN BIOLOGY
John A. Moore ed. (Barnard Coll., New York) Garden City, N. Y., Nat. Hist. Press, 1965 567 p refs Proc. of the 16th Intern. Congr. of Zoology, vol. 6, Held in Washington, 20–27 Aug. 1963
(Grant NsG-364)
(NASA-CR-81382) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00 CSCL 06C

1. THE DUPLICATION AND RECOMBINATION OF GENES M. S. Meselson (Harvard Univ.) p 3–16 refs (See N67-16702 07-04)

2. GENE ACTION S. Speigelman (Ill. Univ.) p 17–78 refs (See N67-16703 07-04)

3. A GENERAL VIEW OF CELL STRUCTURE AND FUNCTION E. De Robertis (Buenos Aires Univ.) p 81–93 refs (See N67-16704 07-04)

4. ILLUSTRATIONS OF CELL FINE STRUCTURE K. R. Porter (Harvard Univ.) p 95–123 (See N67-16705 07-04)

5. THE SYNTHESIS OF MACROMOLECULES V. M. Ingram (MIT) p 125–171 refs (See N67-16706 07-04)

6. THE TRANSFER OF ENERGY WITHIN CELLS A. L. Lehninger (JHU) p 173–202 refs (See N67-16707 07-04)

7. QUESTIONS POSED BY CLASSICAL DESCRIPTIVE AND EXPERIMENTAL EMBRYOLOGY J. M. Oppenheimer (Bryn Mawr Coll.) p 205–227 refs (See N67-16708 07-04)

8. MECHANISMS OF CELLULAR DIFFERENTIATION C. L. Markert (JHU) p 229–258 refs (See N67-16709 07-04)

9. CELLULAR INTERACTIONS IN DEVELOPMENT M. Abercrombie (Univ. Coll.) p 259–280 refs (See N67-16710 07-04)

10. THE EFFECTS OF GENETIC CHANGE AT DIFFERENT LEVELS J. M. Rendel (Commonwealth Sci. and Ind. Res. Organ.) p 283–295 refs (See N67-16711 07-04)

11. SELECTION IN AND OF POPULATIONS R. C. Lewontin (Chicago Univ.) p 297–311 refs (See N67-16712 07-04)

12. EVOLUTION AT THE SPECIES LEVEL E. Mayr (Harvard Univ.) p 313–325 refs (See N67-16713 07-04)

13. EVOLUTION IN GEOLOGICAL TIME B. Kurten (Geol. Inst.) p 326–354 refs (See N67-16714 07-13)

14. LEVELS OF BIOLOGICAL ORGANIZATION AND THEIR PHYSIOLOGICAL SIGNIFICANCE C. L. Prosser (Ill. Univ.) p 357–390 refs (See N67-16715 07-04)

15. COMPARATIVE MORPHOLOGY AND PHYSIOLOGY OF EXCRETION B. Schmidt-Nielsen (Western Reserve Univ.) p 391–425 refs (See N67-16716 07-04)

16. PHYLOGENETIC RELATIONS OF THE MAJOR GROUPS OF ANIMALS G. S. Carter (Cambridge Univ.) p 427–445 refs (See N67-16717 07 04)

17. PHYSIOLOGICAL BASES OF BEHAVIOR T. H. Bullock (Calif. Univ.) p 449–482 refs (See N67-16718 07-04)

18. THE ONTOGENY OF BEHAVIOR W. H. Thorpe (Cambridge Univ.) p 483–518 refs (See N67-16719 07-04)

19. BEHAVIOR AND NATURAL SELECTION N. Tinbergen (Oxford Univ.) p 519–542 refs (See N67-16720 07-04)

N67-16702* Harvard Univ., Cambridge, Mass. Biological Labs.
THE DUPLICATION AND RECOMBINATION OF GENES
Matthew S. Meselson *In* NAS–NRC Ideas in Mod. Biol. 1965 p 3–16 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

The mechanism of the genetic substance, deoxyribonucleic acid (DNA), is discussed in connection with genetic duplication processes. The circularity of DNA molecules in certain bacterial and mammalian viruses is surveyed, together with details on its discovery, *in vitro* synthesis, duplication mechanics, and autoradiographic investigation. Two completely different explanations are advanced on genetic recombination and the interactions between homologous DNA molecules that give rise to molecules having nucleotide sequences derived partly from one and partly from another of the partners to the interaction. Four different reactions are cited in the mechanism of recombination: breaking DNA strands, excising portions of strands, resynthesizing them, and joining them to other strands in phosphodiester linkage. R.Li.

N67-16703* Illinois Univ., Urbana. Dept. of Microbiology.
GENE ACTION
S. Spiegelman *In* NAS–NRC Ideas in Mod. Biol. 1965 p 17–78 refs Sponsored by Public Health Serv. and NSF (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

The genetic transcription method, and the factors controlling the generation of genetic messages are reviewed. In the experimental analyses conducted, two devices were found useful. The deoxyribonucleic acid-ribonucleic acid hybridization test was converted into a sensitive and powerful tool by the use of isotopic labeling and the RNAase resistance of hybrid structures. By this means it was possible to search for, and detect, sequences corresponding to as little as 0.01 percent of an *E. coli* genome. The other technique involved the two-label simultaneous chromatographic method, which permits the detection and identification of genetic messages generated by particular loci. Procedures making it possible to perform informative experiments were derived from these two methods combined with certain other physical methods (equilibrium density-gradient centrifugation, liquid scintillation spectrometry). R.Ll.

N67-16704* Buenos Aires Univ. (Argentina). Inst. of General Anatomy and Embryology.
A GENERAL VIEW OF CELL STRUCTURE AND FUNCTION
E. de Robertis *In* NAS-NRC Ideas in Mod Biol. 1965 p 81–93 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Three examples are mentioned in which cell structure was correlated with cell physiology. Studies were made of the macromolecular organization and the bearing on the problem of replication of the deoxyribonucleic acid (DNA) molecule. Comparisons were made of cell structure and cell function in nuclear and cytoplasmic ribonucleic acid (RNA) systems, in cytoplasmic membranes, and in relation to neurons and synaptic junctions. A similar correlation is made in one of the most specialized cytoplasmic components of nerve cells. R.Ll.

N67-16705* Harvard Univ., Cambridge, Mass. Biological Labs.
ILLUSTRATIONS OF CELL FINE STRUCTURE
Keith R. Porter *In* NAS–NRC Ideas in Mod. Biol. 1965 p 95–123 (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

To illustrate the fine cell structure found in the majority of animals, several high-resolution electron micrographs are reproduced. Prominent formed elements of the cytoplasm can be discerned, and the cell nucleus, one of the best known organnelles of the cell, as well as mitochondria are readily identified in other views. Also depicted are: changes in the reticulum of exocrine pancreas cells of a guinea pig, associated with zymogen synthesis; a primary oocyte of the mosquito *Aedes aegypti*; numerous profiles of the endoplasmic reticulum (ER) and a dense population of ribosomes, both attached to the membranes and free in the cytoplasmic matrix; nine triplet arrangements of microtubules; the region of contrast between two epithelial cells from the mucosa of the bat's stomach; the active transport of specific ions between environment and cytoplast; and some features of the caudal sheath found in spermatids of the laboratory mouse. R.Ll.

N67-16706* Massachusetts Inst. of Tech., Cambridge. Div of Biochemistry.
THE SYNTHESIS OF MACROMOLECULES
Vernon M. Ingram *In* NAS–NRC Ideas in Mod. Biol. 1965 p 125–171 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Recent discoveries bearing on the mechanism for biosynthesis of deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and protein molecules are described. Technical data are presented on such topics as: the biochemical mechanism of DNA biosynthesis and its replication; chemical composition of synthesized DNA, its physical properties, and nucleotide sequences; radioactivity measurements in experiments with *mycobacterium phlei* DNA as primer; the biosynthesis and configuration of RNA in solution; solubility and RNA-dependent RNA polymerase; the general scheme, mechanism, and requirements of protein synthesis; structure of ribosomes in *E. coli*; structure of polyribosomes (polysomes); the assembly of a peptide chain; and polyribonucleotides and the genetic code. A summary of RNA code words is included. R.Ll.

N67-16707* Johns Hopkins Univ., Baltimore, Md. Dept. of Physiological Chemistry.
THE TRANSFER OF ENERGY WITHIN CELLS
Albert L. Lehninger *In* NAS–NRC Ideas in Mod. Biol. 1965 p 173–202 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Certain theoretical, biochemical, and ultrastructural considerations are presented on the basic features of energy transfer in biological cells. Emphasis is on the energy transfer mechanisms involved in respiration and oxidative phosphorylation in the mitochondrion. The more general aspects of the cellular energy cycle, and the major endergonic processes dependent on adenosine triphosphate (ATP) (biosynthesis, active transport, and contractile processes) are outlined. Summarized conclusions indicate that the respiratory assembly of enzymes in the mitochondrial membrane does the scalar work of ATP formation, the vectorial osmotic work of active transport, and also the tensorial mechanical work of contraction. R.Ll.

N67-16708* Bryn Mawr Coll., Pa. Dept. of Biology.
QUESTIONS POSED BY CLASSICAL DESCRIPTIVE AND EXPERIMENTAL EMBRYOLOGY
Jane M. Oppenheimer *In* NAS–NRC Ideas in Mod. Biol. 1965 p 205–227 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Historical contributions made by classical embryology toward a solution of the problem of how an egg and embryo develop into an adult organism are discussed. Topics mentioned include: functional adaptation; the relative significance of dependent versus independent differentiation; experiments testing the effects on development of stimuli from the external surroundings; the doctrine of self-differentiation, and interaction of developing embryonic parts; tissue affinity, aggregation and disaggregation of cells; significance of the division of chromatin; relationship of quantity to quality; separation of blastomeres of echinoderm eggs; cellular differentiation; nature of the mathematical and physical characteristics of a cleaving egg; time-sequences in ontogenetic processes; and causes and effects in terms of nucleus and cytoplasm. Also, to ascertain the physiological relationships between cell structure and cell processes, studies were conducted on centrosome, nucleus and cytoplasm. R.Ll.

N67-16709* Johns Hopkins Univ., Baltimore, Md. Dept. of Biology.
MECHANISMS OF CELLULAR DIFFERENTIATION
Clement L. Markert *In* NAS–NRC Ideas in Mod. Biol. 1965 p 229–258 refs Sponsored by AEC, NSF, and Am. Cancer Soc. (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Popular biological and physiological views on the course of gene function are reviewed. Cell differentiation is here defined as a phenomenon in developmental biology viewed as the product of the reciprocal interaction of genome and environment, leading to differential gene function. Evidence from a variety of sources (experimental embryology, genetics, and biochemistry) support the conclusion that differential gene function characterizes the diverse cells of metazoans. It is stated that during repeated cell division, or under extreme environmental provocation, the differentiated state of the chromosome may be changed so as to express new patterns of gene function. R.Ll.

N67-16710* University Coll., London (England). Dept. of Zoology.
CELLULAR INTERACTIONS IN DEVELOPMENT
M. Abercrombie *In* NAS–NRC Ideas in Mod. Biol. 1965 p 259–280 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Consideration is given to embryonic cell response to signals, cellular differentiation, and movements. A generalization is made that most of the interactions that control the various components of cell movement involve contact between the cells, and that adhesion is commonly the significant aspect of the contact. The changing patterns of signals within an embryo, eliciting an ever shifting array of responses many of which are themselves new signals, is found to be of infinite variety. Examples are presented of cell movement that chiefly illustrate how it may be started and how it may be appropriately stopped. R.Ll.

N67-16711* Commonwealth Scientific and Industrial Research Organization, Sydney (Australia).
THE EFFECTS OF GENETIC CHANGE AT DIFFERENT LEVELS
J. M. Rendel *In* NAS–NRC Ideas in Mod. Biol. 1965 p 283–295 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

The evolutionary selection process outlined involves the action of natural selection on existing genes. It takes place at the first level of gene change and is assumed to play a part at every other level as well. A crude outline classifies two additional types of genetic changes that can be expected to have taken place in evolution. The consequences of genetic redundancy, the introduction of new genetic material, the deoxyribonucleic acid (DNA) content of some nuclei in picograms are also briefly mentioned. R.Ll.

N67-16712* Chicago Univ., Ill. Dept. of Zoology.
SELECTION IN AND OF POPULATIONS
R. C. Lewontin *In* NAS–NRC Ideas in Mod. Biol. 1965 p 297–311 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden N. Y.: $8.00 City.

Principles determining evolution processes, and genetic selection in and out of populations are summarized. These processes are: proliferation by which the number of independently evolving units increases, phyletic evolution by which the kind and frequency of characters and character complexes change over time, and extinction with its irrevocable loss of taxonomic and organic diversity. Within populations the result of natural selection is to change the frequency of genotypes to maximize the intrapopulation fitness. Between populations it is the probability of population survival that is maximized and the net result is a compromise between these forces, the degree to which one or the other is important depending on the autecology of the species. R.Ll.

N67-16713* Harvard Univ., Cambridge, Mass. Museum of Comparative Zoology.
EVOLUTION AT THE SPECIES LEVEL
Ernst Mayr *In* NAS–NRC Ideas in Mod. Biol. 1965 p 313–325 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Consideration is given to the species border which is the point of compromise between the need for adaptation to local conditions and the limitations set by the species-wide components of the genotype. Genetic cohesion and the multiplication of species interactions are covered, along with variation within natural populations and major mutations in species multiplication. The rapid speciation process that occurs when a founder population becomes established beyond the periphery of the species range, thus undergoing a genetic revolution, is the focal point discussed. The highly unequal rates of speciation are noted. R.Ll.

N67-16715*# Illinois Univ., Urbana. Dept. of Physiology and Biophysics.
LEVELS OF BIOLOGICAL ORGANIZATION AND THEIR PHYSIOLOGICAL SIGNIFICANCE
C. Ladd Prosser *In* NAS–NRC Ideas in Mod. Biol. 1965 p 357–390 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Physiological properties during chemical and organic evolution are considered in relation to levels of biological organization. Theory is postulated on the theory of emergence of qualitatively different properties in integrated whole organisms; information theory as a formal description of the relation between parts and wholes; randomness detected in genetic change, in individuals in a population, and in the central nervous system. Several examples are listed to explain the evolutionary meaning of emergence. R.Ll.

N67-16716* Western Reserve Univ., Cleveland, Ohio. Dept. of Biology.
COMPARATIVE MORPHOLOGY AND PHYSIOLOGY OF EXCRETION
Bodil Schmidt-Nielsen *In* NAS–NRC Ideas in Mod. Biol. 1965 p 391–425 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

The kidney or its analogous structure in the various phyla is investigated together with the function of the other numerous excretory organs as they pertain to the kidney function. The cellular structure and function of the amoeba is considered as the most primitive kind of kidney and an example of the contractile vacuole. Emphasis is on the functional aspects determining the osmolality of the tabular fluid and the final urine. Examples are provided for the excretory tubule of fresh-water animals, and the short, undifferentiated tubules of marine forms. Also reported are investigations on the osmotic concentration in the rectal fluid of fly larvae, and the concentrating mechanism of the mammalian kidney. Numerous informative charts and diagrams are included. R.Ll.

N67-16717* Cambridge Univ. (England). Dept. of Zoology.
PHYLOGENETIC RELATIONS OF THE MAJOR GROUPS OF ANIMALS
G. S. Carter *In* NAS-NRC Ideas in Mod. Biol. 1965 p 427–445 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Theory is advanced on the technique of determining how the major groups of animals are related to each other in the evolutionary process. Zoological concepts and views on the phylogeny of the animal kingdom are reviewed, and paleontological evidence showing the course of evolution is summarized. Homomorphosis and the problem of phyla interrelationships are also covered briefly. R.Ll.

N67-16718*# California Univ., Los Angeles. Dept. of Zoology.
PHYSIOLOGICAL BASES OF BEHAVIOR
Theodore Holmes Bullock *In* NAS-NRC Ideas in Mod. Biol. 1965 p 449–482 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Contemporary efforts to bridge the gap between physiology and behavior are surveyed. Issues concerned with the peripheral mechanisms underlying behavior are investigated by the physiology of sense organs from peripheral receptors and effectors, through lower-level integrative mechanisms, up to higher integrations. As an example of the advancement in knowledge concerning capacities of receptors, (thermoreceptors, photoreceptors, mechanoreceptors, or chemoreceptors) the discovery of the electroreceptor is cited; another example is that of the inner ear of the frog. Integrative mechanisms both at the level of small number of cells, as well as at high levels are also analytically reported. R.Ll.

N67-16719*# Cambridge Univ. (England). Sub-Dept. of Animal Behavior.
THE ONTOGENY OF BEHAVIOR
W. H. Thorpe *In* NAS–NRC Ideas in Mod. Biol. 1965 p 483–518 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Analytical details concerning the main ideas and advances of behavorial ontogeny and the learning processes are evaluated. Theoretical concepts are advanced on such topics as: habituation, the simplest type of learning, in the process of adjusting innate behavior patterns to environmental situations; the conditioned reflex and the classical interoceptive conditioning; trial-and-error learning involving the motor-conditioned reflex; the principle of expectancy and reward in animal learning; and sensitive periods and imprinting techniques during experiments on the song-learning of the chaffinch (Fringilla Coelebs). R.Li.

N67-16720* Oxford Univ. (England). Dept. of Zoology.
BEHAVIOR AND NATURAL SELECTION
N. Tinbergen *In* NAS–NRC Ideas in Mod. Biol. 1965 p 519–542 (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

Genetic–environmental interactions in the behavioral control and development of animals are evaluated in respect to the animal's ability to survive and reproduce itself. One investigative method cited involves singling out a particular environmental pressure, a challenge to survival, and investigating how an animal meets this challenge. Another technique of the methodology is to start from an observable property of an animal of which the function is unknown, and examine in what respect it contributes to survival, and how it does so. The hypothesis is advanced that accepting the theory of natural selection should not afford an excuse not to investigate concrete survival mechanisms. R.Li.

N67-16775*# Republic Aviation Corp., Farmingdale, N. Y.
THE INFLUENCE OF DIET ON THE NORMAL FECAL FLORA OF THE CHIMPANZEE Final Report, Feb. 1964–Feb. 1965
Lorraine S. Gall Holloman AFB, N. Mex., Aeromed. Res. Lab., Nov. 1965 228 p refs Prepared Jointly with Wisconsin Univ.
(NASA Order R-25; Contract AF 29(600)-4555)
(NASA-CR-81320; ARL-TR-65-21; RAC-1787-5FR) CFSTI: HC $3.00/MF $0.65 CSCL 06C

A study was undertaken to determine the effect of diet on the aerobic and anaerobic fecal flora of twelve chimpanzees. The aerobic bacteria isolated were more markedly influenced by the individual animal than by diet. This was particularly true of gram negative rods, such as proteus, pseudomonas, untypable cultures, and possibly klebsiella and certain typable beta hemolytic streptococci. Two types of bacteria, salmonella and peculiar beta-hemolytic gram positive bacillus, were diet-oriented and may have been carried in on or were favored by the diets. An overall simplification of the aerobic flora occurred after the twelve chimpanzees had been isolated from other chimpanzees for a prolonged period of time. The distribution of anaerobic bacteria in the feces both strict and facultative anaerobes was influenced markedly by the diet fed and to a lesser extent by the individual animal. The predominance of anaerobes over aerobes and the proportion of strict vs facultative anaerobes were influenced by the composition of the diet fed, and to a lesser extent the proportion of strict vs facultative anaerobes was influenced by the individual animal. The length of time which the diet was fed also played an important role in the proportion of strict vs facultative anaerobes. Author

N67-16781*# Pennsylvania State Univ., University Park.
THE MOLECULAR ASPECTS OF BIOLOGICAL DEVELOPMENT
R. A. Deering and Muriel Trask, ed. Feb. 1967 213 p refs Workshop held University Park, Pa., 19–21 Jul. 1965
(Grant NsG-324)
(NASA-CR-673) CFSTI: HC $3.00/MF $0.65 CSCL 06C

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N67-16782*# Massachusetts Inst. of Tech., Cambridge. Biology Dept.
RNA PROTEIN SYNTHESIS IN DEVELOPING SEA URCHIN EGGS
Paul R. Gross *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 1–16 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

Some important results obtained from a study of biochemical events, in particular those involved with macromolecule synthesis, that follow immediately after fertilization of sea urchin eggs are discussed. A postulation is made that systems exist for controlling protein synthesis at the level of translaton of RNA messages. Protein synthesis, an inevitable accompaniment of early development, may be uncoupled from the highly nuclease-sensitive RNA. Since under uncoupling conditions new RNA messages are not made, old ones must supply the information for translation which suggests that these messages are stable. Therefore, RNA messages directing early protein synthesis must be present in the egg before fertilization. From this it is concluded that some system of control must exist in the cytoplasm to turn on the reading of stored

messages, since the co-factors necessary for protein synthesis are already available in the unfertilized egg. Experiments that led to this position are discussed and concern the pattern of early RNA synthesis, the search for stored maternal messages, and a study of the proteins themselves. R.N.A.

N67-16783*# Pennsylvania Univ., Philadelphia.
EARLY BIOCHEMICAL EVENTS FOLLOWING FERTILIZATION OF SEA URCHIN EGGS
David Epel *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 17–33 refs (See N67-16781 CFSTI: HC $3.00/MF $0.65
(Grants PHS-G-5-TI-GM-2G77; NSF GB-4206)

A study was made of the temporal sequence and mechanism of the fertilization reactions in sea urchin eggs by monitoring light scattering structural changes, fertilization acid excretion, and activation of DPN kinase and respiration. The data indicate that changes in light scattering and acid excretion begin simultaneously, followed almost immediately by activation of DPN kinase. Respiratory activity increases last. An analysis of these changes suggests that the light scattering and acid changes reflect the breakdown of the cortical granules. DPN kinase activation might be through the free Ca^{+2} release known to occur after fertilization since this enzyme is both Ca^{+2} and Mg^{+2} activated. The respiratory activation mechanism is unclear but the data suggest substrate mobilization, possibly through control of glycogen phosphorylase. R.N.A.

N67-16784*# Purdue Univ., Lafayette, Ind. Biology Dept.
RIBOSOMAL RIBONUCLEIC ACID SYNTHESIS IN RANA PIPIENS EMBRYOS
David E. Kohne *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 35–46 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

A study was made to determine gross aspects of the regulatory processes which control the synthesis of ribosomal-RNA during embryogenesis in *Rana pipiens*. Three experimental embryological systems were employed in this work. Hybrid embryos were used to study the effect of a qualitative change in the genome of *Rana pipiens* on ribosomal-RNA synthesis during development, haploid embryos were used to ascertain the effect on ribosomal-RNA synthesis during development of a quantitative change in the frog genome, and embryos reared in a medium lacking magnesium were studied to determine the effect of magnesium deprivation on ribosomal-RNA synthesis during development. Results for each of these three cases are discussed in detail. R.N.A.

N67-16785*# Connecticut Univ., Storrs. Dept. of Zoology.
MOLECULAR ASPECTS OF LENS CELL DIFFERENTIATION
John Papaconstantinou *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 47–67 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

A system is discussed in which the regulation of synthesis of specific proteins is associated with a specific stage of cellular differentiation, i.e., the differentiaton of the lens epithelial cell to the fiber cell. Changes in RNA and DNA are also described which are associated with fiber cell formation and possibly with the regulation of protein synthesis. The epithelial cells are shown to have basophilic staining properties whereas the fiber cell has acidophilic staining properties. This change in staining properties may be due to the synthesis of gamma-crystallins. There is also a conversion from a rough endoplasmic reticulum in the epithelial cell to a smooth endoplasmic reticulum in the fiber cell. The breakdown and decrease in the ribosomes may be directly related to the appearance of the endoplasmic reticulum. Increases in the nucleus and nucleoli sizes and the ribosomal population at the time of cellular elongation may indicate the initiation of an overall synthesis of materials required for the morphological changes of the cell. An increase in the synthesis of nucleic acids may account for the morphological changes in the nuclei and nucleoli. The fiber cell's nucleus gradually disappears as it ages. This is due to its incapacity to incorporate precursors into its DNA and also a loss of DNA. R.N.A.

N67-16786*# Toronto Univ. (Ontario). Dept. of Medical Biophysics.
PROLIFERATION AND DIFFERENTIATION OF STEM CELLS OF THE BLOOD-FORMING SYSTEM OF THE MOUSE
James E. Till *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 69–75 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

Mutations W, Sl, and f were studied in mice of genotypes W/W^v, Sl/Sl^d, and f/f in an effort to determine the molecular basis for the mutations which are known to produce anemia, and to determine on the basis of the spleen-colony technique what regulates the proliferation and differentiation patterns of the stem cells. Focused upon are the intrinsic and extrinsic genetic changes which could be regulated by a single gene and their relationship to the ability of the stem cell to proliferate so as to maintain its own numbers (self-renewal), and differentiate to give rise to cells of the red cell series, granulocyte series, and the megakaryocytes. S.C.W.

N67-16787*# Yale Univ., New Haven, Conn. Dept. of Biology.
THE STRUCTURE OF ISOZYME SYSTEMS AND THEIR ROLE IN DEVELOPMENT
Edward J. Massaro *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 77–91 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

An analysis of species and tissue specific patterns of lactate dehydrogenase (LDH) isozyme systems and their role during the course of vertebrate and mammalian embryonic development is presented. S.C.W.

N67-16788*# Florida Univ., Gainesville. Dept. of Zoology.
ANTIGEN SYNTHESIS DURING REORGANIZATION IN THE CELLULAR SLIME MOLDS
James H. Gregg *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 93–107 refs (See N67-16781 CFSTI: HC $3.00/MF $0.65

A discussion of the mechanism (antigen synthesis) involved in the differentiation of cells into spores (70%) and stalk cells (30%) during the development of two species of slime molds, *Dictyostelium mucoroides* and *Dictyostelium discoideum*, is presented. Focused upon are the merits of immunological methods (fluorescent antibody) and histochemical techniques used to study cell differentiation in these two slime molds. S.C.W.

N67-16789*# Massachusetts General Hospital, Boston. John Collins Warren Lab.
CONTROL OF ENZYME ACTIVITIES IN D. DISCOIDEUM DURING DEVELOPMENT
Barbara Wright *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 109–122 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

Possible mechanisms for changing the activity of an enzyme are discussed, and the point is made that activity at the enzyme and substrate level must necessarily be correlated in time with the accumulation of the product characteristic of the differentiated cell. The life cycle of *D. discoideum* is summarized, and details are given on experiments conducted with cells starving on 2% agar throughout the differentiation cycle. Among the findings discussed are: (1) the existence in vivo of many limiting factors for the synthesis of materials important to differentiation, which may be the rule rather than the exception; and (2) the striking correlation in the activity of an enzyme and the accumulation of the product of the activity of this enzyme. It was concluded that no single event could possibly trigger cell wall synthesis since a complex

array of primer, substrates, activators, and enzymes are not only limiting but must interact to bring about the accumulation of cell wall material. M.G.J.

N67-16790*# Syracuse Univ., N. Y. Dept. of Zoology.
CELL INTERACTIONS IN SLIME MOLD (ACRASINA) DEVELOPMENT
A. J. Kahn *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 123–129 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

Attention is focused upon the early stages in the life cycle of cellular slime molds, beginning with spores and terminating with the formation of the pseudoplasmodium (aggregate). Details are given on experiments conducted to determine if spacing of aggregates occurs in Polysphondylium *pallidum* and, if it does occur, is it due to a spacing substance present in the gaseous phase of the environment. Emphasis is placed on the relation between nearest neighbor distance and the density of aggregation centers; the correlation between center density and distribution; the influence of environmental and biological factors on the rate of center formation; the inter-relationships between these factors, the rate of center formation, and the distribution and density of centers; and the effects of the rate of center formation on center density and distribution. It is concluded: (1) Nonrandom distribution of spaced or clustered centers occurs. (2) Center distribution is probably not due to a spacing substance present in the gaseous phase. (3) The rate of center formation and the number of cells available for aggregation is involved in establishing center density and distribution. M.G.J.

N67-16791*# California Inst. of Tech., Pasadena. Div. of Biology.
HISTONES IN RELATION TO CONTROL IN LIVING SYSTEMS
Roger Chalkley *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 131–147 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

A broad outline is presented on several studies concerned with the molecular aspects of control mechanisms in differentiated tissues. A general scheme for the isolation of chromatin is discussed, and the chemical compositions of some isolated chromatins are tabulated. Experiments were also conducted to see if the isolated chromosomal material could act as a template for DNA-dependent RNA synthesis, and to compare the template activity of the chromatin with that of DNA which had not been isolated from an identical preparation of chromatin. Other investigations centered on the problems of histone metabolism; the in vitro analysis of RNA synthesis; studies related to the release of dormacy in the potato tuber, to the increase of enzyme activity of the liver induced by hydrocortisone, and to the effects of estradiol in preparing the endometrial layer of the uterus for implantation following fertilization; and a dynamic model for induction and regression. M.G.J.

N67-16792*# Michigan State Univ., East Lansing. Dept. of Botany.
DYNAMICS OF THE POINT OF NO RETURN DURING DIFFERENTIATION IN BLASTOCLADIELLA EMERSONII
Edward C. Cantino *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 149–164 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

Data on the background of B. *emersonii* are reviewed, and the two major developmental pathways taken by the species are identified as (1) an ordinary colorless (OC) cell which is uppermost in the top pathway; and (2) a resistant sporangial (RS) cell which is uppermost in the lower pathway. As it was found that in the presence of exogenous bicarbonate, essentially all spores developed along the RS pathway, and in its absence along the OC between exponential growth of the RS cell and its subsequent differentiation is also considered, and the morphological point of no return during RS development in B. *emersonii* is depicted. Also considered is the source and intracellular localization of the reducing power necessary for driving the reductive carboxylation of ketoglutarate to isocitrate. Hypotheses are proposed regarding the effect of bicarbonate on glucose-6D glucose-6-phosphate dehydrogenase, and the effect of morphological reversal on the specific activity of free glucose in an RS cell. M.G.J.

N67-16793*# Purdue Univ., Lafayette, Ind. Dept. of Biological Sciences.
NUCLEIC ACID SYNTHESIS DURING DIFFERENTIATION OF BLASTOCLADIELLA EMERSONII
James S. Lovett *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 165–181 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

The formation of zoospores and their germination are described, with interest centered on the control mechanisms for the cellular regulation of differentiation, and on nuclei acids and the spore nuclear cap. Several observations concerning the structure and function of the nuclear cap are examined. These seem to indicate that the reappearance of the ribosomes in the cytoplasm at germination could result from synthesis of new ribosomes at the expense of the cap ribonucleoprotein, or from migration of the pre-existing ribosomes. Experimental data on zoospore formation, and RNA synthesis in particular, suggest that new ribosomal RNA—and apparently transfer RNA—synthesis is not necessary for spore formation. Results also show that the pattern of synthesis and early differentiation of the spores, to the stage where they form a tiny, uninucleate plant with a fairly long, branched rhizoid, occurs whether the spores are in the growth medium or not. M.G.J.

N67-16794*# Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences.
THE MOLECULAR ASPECT OF NUCLEIC ACID INTERACTIONS
Paul O. P. Ts'O *In* Pa. State Univ. The Mol. aspects of Biol. Develop. Feb., 1967 p 183–194 refs (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

Details are given on thermodynamic and spectroscopic methods used in studying the properties of monomers in solution. The data obtained on the extensive stacking interaction of the bases of nucleic acid in aqueous solution are applied to investigations of polymer–monomer interactions. Also described are the important parameters and the basic information about the forces responsible for the secondary structure of nucleic acids, which resulted from these experiments. M.G.J.

N67-16795*# Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences.
THE PROBLEMS AND PROMISES OF RESEARCH ON THE MOLECULAR ASPECTS OF DEVELOPMENT Workshop Summary
Paul O. P. Ts'o *In* Pa. State Univ. The Mol. Aspects of Biol. Develop. Feb. 1967 p 195–201 (See N67-16781 07-04) CFSTI: HC $3.00/MF $0.65

Problems and progress in the field of developmental biology are reviewed, and some general consensuses and conclusions are presented. Particular consideration is given to unicellular organisms and to a unicellular model; a more precise agreement as to what constitutes differentiation; and the concept of the decision-making process within cells. The nuclear–cytoplasm relationship is redefined, with this relationship identified as the most important cellular factor to be considered. The need for better communications, and the basic problems of developmental biology in terms of biochemical hardware and mechanism are discussed in relation to the progress foreseen for the next decade. M.G.J.

N67-16893# Honeywell, Inc., St. Paul, Minn. Research Dept.
THE EFFECTS OF HIGH-INTENSITY RADIANT STIMULATION OF VARYING WAVELENGTHS AND DURATIONS ON RETINAL SENSITIVITY Annual Progress Report, 1 Jul. 1965–1 Jul. 1966
H. G. Sperling, N. A. Sidley, W. B. Dockens, and C. L. Jolliffe 30 Sep. 1966 20 p refs
(Contract DA-49-193-MD-2457)
(Doc.-1549-TDR3; APR-3; AD-642318) CFSTI: HC $3.00/MF $0.65

The report presents data on the spectral sensitivity of the eye for a baseline condition of 3000 trolands of planckian-radiator (white) light, and a comparison with the eye's sensitivity when 10,000 trolands of a narrow-band radiation from the blue, green or red parts of the spectrum are added to the white light. The results show a quantitatively greater reduction of sensitivity over the spectral region of the added spectral light, which qualitatively appears to take the form of nearly or completely eliminating the peak found in that region of the spectrum under the white-light condition. There is less effect on the adjacent parts of the function. These results begin to suggest spectral mechanisms which have considerably narrower ranges of spectral sensitivity than are shown in rod and isolated-cone photopigment spectral bleaching data. The questions which these results raise with regard to currently proposed general explanations of color and brightness vision are discussed. Author (TAB)

N67-16957# Air Force Missile Development Center, Holloman AFB, N. Mex. Mechanical Section.
ENVIRONMENTAL SYSTEM DEVELOPMENT FOR RAPID DECOMPRESSION OF CHIMPANZEES TO PRESSURES LESS THAN TWO TORR
Tommy L. Dobson *in* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 16 p (See N67-16941 07-34)
CFSTI: HC $3.00/MF $0.65

Eighteen tests have been performed, in which were chimpanzees decompressed from 179 torr (35,000 feet) to less than two torr (135,000 feet) in one second using a 100 percent oxygen atmosphere. This research is being performed so that mission rules, safety procedures, and necessary engineering designs may be incorporated into manned spacecraft to assure maximum chances of mission success for astronauts. Existing chambers, equipment, and instrumentation were used as much as possible. New test methods and safety procedures were developed. Several problems were encountered in the development of this unique test capability, and these problems and their solutions are described. Future test requirements will include decompression pressures below one torr and helium-oxygen atmosphere. A short description of the results of the present test program is included. Author

N67-17017# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
PERFORMANCE OF RHESUS MONKEYS DURING CONTINUOUS LOW-LEVEL GAMMA RADIATION: AN EXPLORATORY STUDY Interim Report
Robert G. Braun, Donald N. Farrer, William Zappini, and Guy H. Crook, II Oct. 1966 29 p refs
(ARL-TR-66-18; AD-641331)

Six rhesus monkeys, two males and four females weighing 4.8 to 5.3 kg, were trained to perform four operant tasks (Continuous Avoidance, Response Time Following an Auditory Cue, Response Time Following a Visual Cue and a Fixed Ratio Task). Baseline performance was obtained in the laboratory during a 30-day simulated exposure situation. The exposure phase involved a 10-day pre-exposure baseline, 10 days of continuous exposure to 2r per hour gamma radiation, and a 10-day post-exposure follow-up assessment of performance. A 30-day follow-up was also conducted 60 days following the exposure phase. No performance diminutions were discovered on the aversively motivated tasks, but a performance diminution in the food rewarded fixed ratio task occurred during the radiation exposure. All the animals recovered shortly after the exposure and still appeared normal 8 months later. Author (TAB)

N67-17018# Kansas State Univ., Manhattan. Dept. of Psychology.
SENSITIVITY AND SPECTRAL RESPONSE PROPERTIES OF HUMAN VISION AT LOW LUMINANCES Technical Report, Oct. 1966
John Lott Brown 14 Oct. 1966 31 p refs Presented at Sem. on Electro-Opt. Aids to Night Vision, Arlington, Va., May 1966
(Contract Nonr-3634(04))
(TR-2; AD-640555) CFSTI: HC $3.00/MF $0.65

The sensitivity of human vision is considered in relation to level of adaptation, luminance and spectral distribution of available light and the visual tasks to be performed. The relevance of these considerations to aided and unaided vision at low luminances is discussed. Author (TAB)

N67-17081# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).
PAPERS OF DVL-INSTITUTE FOR AEROMEDICINE AT VIth INTERNATIONAL AND XIIth EUROPEAN CONGRESS OF AVIATION AND SPACE MEDICINE IN ROME AND AT THE XIIIth INTERNATIONAL CONGRESS OF AVIATION AND SPACE MEDICINE 1964 IN DUBLIN [VORTRAGE AUS DEM INSTITUT FUR FLUGMEDIZIN GEHALTEN AUF DEM. VI. INTERNATIONALEN UND XII. EUROPAISCHEN KONGREB FUR LUFT-UND RAUMFAHRTMEDIZIN IN ROM 1963 UND DEM. XIII: INTERNATIONALEN KONGREB FUR LUFT- UND RAUMFAHRTMEDIZIN IN DUBLIN 1964]
W. Briegleb Sep. 1965 45 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-40) CFSTI: HC $3.00/MF $0.65

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7. THE INFLUENCE OF WEIGHTLESSNESS ON CELL FUNCTION W. Briegleb p 37–42 refs (See N67-17088 07-04)

N67-17082# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).
THERAPY AGAINST DECOMPRESSION SICKNESS [DIE BEHANDLUNG DER DRUCKFALLKHEIT]
H. Hartmann *In its* Papers of DVL-Inst. for Aeromed. at VIth Intern. and XIIth European Congr. of Aviation and Space Med. in Rome and at the XIIIth Intern. Congr. of Aviation and Space Med. 1964 in Dublin Sep. 1965 p 7–10 (See N67-17081 07-04)
CFSTI: HC $3.00/MF $0.65

Presented and discussed are the recompression tables to be used by underwater divers, or other personnel exposed to

pressurized atmospheres, in case of decompression sickness. Given are exact repressurization values for the different degrees of bends—for pain symptons only as well as for the more serious symptoms of unconsciousness, cramps, weakness of limbs, air emboly, disturbed vision, dizziness and vomiting, severe breathing difficulties, and suffocation spasms. Injections of heparin to dissolve microthromboses, together with intravenous fluid feedings are recommended to prevent lung and brain edema in the more severe cases. Transl. by G.G.

N67-17083# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).

ADAPTATION TO AN UNSPECIFIC STRESS [ANDERUNG VON ENZYMAKTIVITATEN IM SERUM ALS AUSDRUCK UNSPEZIFISCHER ANPASSUNG]

H. M. Wegmann, H. Bruener, D. Jovy, and K. E. Klein *In its* Papers of DVL-Inst. for Aeromed. at VIth Intern. and XIIth European Congr. of Aviation and Space Med. in Rome and at the XIIIth Intern. Congr. of Aviation and Space Med. 1964 in Dublin Sep. 1965 p 11–17 refs (See N67-17081 07-04) CFSTI: HC $3.00/MF $0.65

For 12 weeks duration, human male subjects underwent daily 60 minutes exposure to an oxygen deficient atmosphere in order to observe their changes in blood serum enzyme activity during adaptation to stress. Outputs of their lactate dehydrogenase (LDH), maleate dehydrogenase (MDH), aldolase, and glucose 6-phosphate dehydrogenase, as well as the number of eosinophile blood cells and free 17-hydroxy corticosteroid in blood plasma were analyzed and showed that: (1) acute hypoxia increased all enzyme activities in the blood; and (2) their equilibrium values and their maximal reactions during acclimatization resembled adrenocortical reactions. Transl. by G.G.

N67-17084# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).

THE MECHANISM OF THE SEROUS STRESS REACTION [PHYSIOLOGISCHE ADAPTATION DURCH FERMENTINDUKTION]

G. Schaefer and K. H. Weiner *In its* Papers of DVL-Inst. for Aeromed. at VIth Intern. and XIIth European Congr. of Aviation and Space Med. in Rome and at the XIIth Intern. Congr. of Aviation and Space Med. 1964 in Dublin Sep. 1965 p 18–19 (See N67-17081 07-04) CFSTI: HC $3.00/MF $0.65

Physiological adaptation of body functions to stress situations rests on adrenocortical induced changes in body enzyme concentrations. Hypoxia of fasting rats increased liver glycogen production within 24 hours. The same effect was obtained by giving hungry animals doses of cortisol; this triggered increased output concentrations of those ferments that were elementary for glycose formation from albumin. Transl. by G.G.

N67-17085# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).

THE BIOCHEMICAL PRIMARY EFFECTS IN RADIATION DAMAGE [CHEMISCHER STRAHLENSCHUTZ BEI FLUGEN IN GROBEN HOHEN UND IN DER BEMANNTEN RAUMFAHRT]

G. Schaefer and K. H. Weiner *In its* Papers of DVL-Inst. for Aeromed. at VIth Intern. and XIIth European Congr. of Aviation and Space Med. in Rome and at the XIIIth Intern. Congr. of Aviation and Space Med. 1964 in Dublin Sep. 1965 p 20–23 (See N67-17081 07-04) CFSTI: HC $3.00/MF $0.65

Various sulfhydryl containing compounds were surveyed for their preventive properties against radiation damage in animal systems, and cysteamin and β-aminoethyl-iso-thiuronium (AET) were found biologically effective because of their available free SH-groups. The toxicity of these compounds, however, limits application to prophylaxis or short duration radiation exposure. Very good protective effects in humans were obtained by doses of the vitamin B_6 given during the development stage of radiation induced sickness. Transl. by G.G.

N67-17086# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany).

CLINICAL PICTURE OF THE SHIFTED DIURNAL RHYTHM DURING JET FLIGHTS [ERMUDUNGSUNTERSUCHUNGEN AUF TRANSATANTIKFLUGEN (VORLAUFIGE MITTEILUNG)]

H. Bruener, K. E. Klein, S. Ruff, and H. M. Wegmann *In its* Papers of DVL-Inst. for Aeromed. at VIth Intern. and XIIth European Congr. of Aviation and Space Med. 1964 in Dublin Sep. 1965 p 24–29 refs (See N67-17081 07-04) CFSTI: HC $3.00/MF $0.65

Physiological and physical parameter measurements on flying personnel of transoceanic jets were evaluated to obtain an index on circulatory shifts. Observed were pulse, systolic blood pressure and amplitude at start and landing. General decreased blood circulation values were clearly related to flight conditions and durations, and manifested themselves outwardly in fatigue symptoms. Transl. by G.G.

N67-17087# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany).

EXPLOSION AND DECOMPRESSION INJURIES [BIOLOGISCHE ERGEBNISSE DER DETONATIONS UND DRUCKFALLFORSCHUNG]

O. Wuensche *In its* Papers of DVL-Inst. for Aeromed. at VIth Intern. and XIIth European Congr. of Aviation and Space Med. in Rome and at the XIIIth Intern. Congr. of Aviation and Space Med. 1964 in Dublin Sep. 1965 p 30–38 (See N67-17081 07-04) CFSTI: HC $3.00/MF $0.65

A sudden atmospheric pressure decrease damages human organs substantially by inducing lung lesions and hypoxemia, slowing of the heart-blood circulation, fat embolism and insufficiency of the hear chambers. The relationship between maximal pressure, exposure time, and decompression velocity is of deciding biological importance on the number of surviving animals; the number of decreased animals increases with prolonged exposure time to decompression and increased decompression pressure differences. Shock-free depressurization effects produced intra- and extravenous gas bubbles through alveolar air diffusion into the blood system. Transl. by G.G.

N67-17088# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany).

THE INFLUENCE OF WEIGHTLESSNESS ON CELL FUNCTION [EIN BEITRAG ZUR FRAGE PHYSIOLOGISCHER SCHWERELOSIGKEIT]

W. Briegleb *In its* Papers of DVL-Inst. for Aeromed. at VIth Intern. and XIIth European Congr. of Aviation and Space Med. in Rome and at the XIIIth Intern. Congr. of Aviation and Space Med. 1964 in Dublin Sep. 1965 p 37–42 refs (See N67-17081 07-04) CFSTI: HC $3.00/MF $0.65

Macroscopic or microscopic changes in algae cells, exposed to simulated weightlessness conditions in thermally controlled, slow horizontal-rotating apparatus, were analyzed for their geotropic reaction. Light orientating conditions on algae cultures, rotating at 140 and 350 turns per minute for 4 weeks, did not produce any changes in their growth habit and direction. Transl. by G.G.

N67-17198# Zurich Univ. (Switzerland). Dept. of Anatomy.

PULMONARY PATHOLOGY OF OXYGEN TOXICITY. PART I: ELECTRON MICROSCOPIC AND MORPHOMETRIC STUDY OF RAT LUNGS EXPOSED TO 98.5% O_2 AT ATMOSPHERIC PRESSURE

Ewald R. Weibel and Gonzague S. Kistler 31 Jan. 1965 43 p refs
(Contract AF 61(052)-784)
(ASR-1; AD-642418) CFSTI: HC $3.00/MF $0.65

Rats were exposed to pure oxygen at 1 atm. The lungs were investigated by electron microscopy using morphometric methods. First damage occurred during the second day and progressed. Capillary blood volume decreased; air-blood barrier increased in thickness. The degree of impairment of pulmonary function was calculated. Author (TAB)

N67-17220# Sao Paulo Univ. (Brazil). Biochemistry Lab.
THE CONTROL OF NUCLEIC ACID SYNTHESIS IN THE SALIVARY GLANDS OF RHYNCHOSCIARA ANGELAE Final Report, Aug. 1965–Jul. 1966
Francisco J. S. Lara Aug. 1966 25 p refs
(Grant DA-ARO-49-092-65-G84)
(AD-640929) CFSTI: HC $3.00/MF $0.65

Methods were developed for extraction of RNA from salivary glands of Rhynchosciara, yielding high quality preparation as judged by hydrodynamic properties. By this method and pulse labeling the synthesis of RNA in the glands throughout larval development was studied. The principal class of RNA synthesized before the appearance of the large puffs is a 35S RNA. This RNA is subsequently transformed into ribosomal RNA. After appearance of the large puffs one observes almost complete inhibition of synthesis of ribosomal precursor. This correlation indicates the material produced in puffs is important in control of synthesis of RNA. Author (TAB)

N67-17243# School of Aerospace Medicine, Brooks AFB, Tex.
THE STEREOSCOPIC ANGLE AND ITS RELATIONSHIP TO THE STANDARD AIR FORCE TESTS FOR DEPTH PERCEPTION, 1 NOVEMBER 1965–15 APRIL 1966
Constantine A. Ricciardi, Benjamin Kislin, and Alton J. Rahe Aug. 1966 27 p refs
(SAM-TR-66-70; AD-640932) CFSTI: HC $3.00/MF $0.65

The three standard Air Force depth perception tests for pilot and observer qualification are the Vision Test Apparatus--Near and Distant (VTA-ND), Verhoeff Stereopter (DPA-V), and Howard-Dolman apparatus (H-D). The stereoscopic angle for the VTA-ND is 25 seconds of arc, 32 seconds for the DPA-V, and 11 seconds for the H-D. An enlarged Verhoeff (SAM-V) was utilized at equivalent calculated distances to compare with the three instruments under their individual parallactic angle conditions. Data analysis showed the following: (1) Employment of the standard criteria for flying qualification resulted in the Verhoeff passing the greatest number, followed by the VTA-ND, and the H-D. Neither the Verhoeff nor H-D results statistically differed from those of the VTA-ND. (2) The SAM-V generally passed fewer subjects than the corresponding standard tests. The results found with the standard Air Force tests are not a full measure of depth discrimination capability. A test concept is described which would incorporate a dynamic component into depth judgments. Author (TAB)

N67-17318# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PREDICTION OF EXPOSURES FROM AN ELEVATED SOURCE
C. E. Elderkin and W. T. Hinds *In its* Phys. Sci., Vol. I May 1966 p 14–20 refs (See N67-17312 07-13) CFSTI: HC $3.00/MF $0.65

A pair of equations are presented for use in the prediction of exposures from an elevated particulate source in which the plume width and height parameters are related to travel time. Three methods of estimating ground level exposures are discussed, depending on the time and instrumentation available. The data and interpretations leading to the development of these techniques are briefly considered, and the restrictions placed on the techniques are pointed out. A.G.O.

N67-17395*# National Aeronautics and Space Administration, Washington, D. C.
MODELS OF ALLOSTERIC ENZYMES AND THEIR ANALYSIS BY THE GRAPH THEORY METHOD [MODELI ALLOSTERICHESKIKH FERMENTOV I IKH ANALIZ METODOM TEORII GRAFOV]
M. V. Vol'kenshteyn and B. N. Gol'dshteyn Jan. 1967 12 p refs Transl. into ENGLISH from Biokhimiya (Moscow), v. 31, no. 4, Jul.–Aug. 1966 p 679–686
(NASA-TT-F-10651) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Using the very simple example of a dimer protein, possible equilibrium cooperative models intended for description of the properties of allosteric enzymes were considered. Together with indirect cooperation, the "direct" cooperation arising as a result of direct interaction of active centers was investigated. Computations were made for the influence of an allosteric inhibitor and a competitive activator on the activity of an enzyme. The results of the computations made by the graph theory method proposed in an earlier study are in qualitative agreement with the data for aspartate transcarbamylase. The proposed models are described by containing fewer than constants the model of Monod et al. Author

N67-17483# Liege Univ. (Belgium). Laboratoires de Radiobiologies.
CHEMICAL RADIOPROTECTIVE AGENTS [RADIOPROTECTEURS CHIMIQUES] Final Report, 1 Apr. 1964–31 Dec. 1965
Brussels, EURATOM, 1966 30 p refs In FRENCH
(Contract EURATOM-046-64-3 BIOB)
(EUR-2992-f)

Results are summarized from studies on the pharmacology and biochemical effects of certain radioprotective agents on the entire animal and on selected tissues of mice and rats. The radioprotective compounds studied included cysteine, cystamine, cysteamine, cyanide, diethyldithiocarbamate, 5-hydroxytryptamine, and hypothermia. A thorough study was made on the reactions of mouse skin to x radiation and the effects of cysteine and cysteamine on skin radiosensitivity. The effects of the protective agents on growth of Ehrlich tumor, humoral immunity, and reactions to skin grafting were also studied. Cysteamine did not protect the mouse against continuous exposure to a 137Cs γ source. The fresh water algae *Nitella flexilis* was found to be a suitable organism for use in certain radiobiological research. NSA

N67-17509*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AMINO ACID COMPOSITION OF A FACULTATIVE HYDROGEN BACTERIUM
Ho Lee Young, Paul X. Callahan, and Harold P. Klein Washington, NASA, Feb. 1967 5 p refs
(NASA-TM-X-1335) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Cells of *Pseudomonas (Hydrogenomonas) saccharophila* have been analyzed for their amino acid composition. Seventeen amino acids of the cellular proteins were quantitatively determined. The free amino acid pool accounted for less than 3% of the total amino acids of the cells. Author

N67-17614*# National Aeronautics and Space Administration, Washington, D. C.
AMINO ACID INCORPORATION INTO PROTEIN BY RABBIT SPLEEN AND LYMPHNODE MICROSOMES [VKLYUCHENIYE AMINOKISLOT V BELKI MIKROSOMAMI SELEZENKI I LIMFOUZLOV KROLIKA]
R. S. Nezlin Oct. 1966 7 p refs Transl. into ENGLISH from Biokhimiya (Moscow), v. 31, no. 3 1966 p 516–520
(NASA-TT-F-10354) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Incorporation of labeled amino acids into proteins was studied in the spleen and lymph nodes of normal and immune rabbits. The pH 5 fraction from spleen and lymph nodes resulted in very low incorporation. The pH 5 fraction from rabbit liver was therefore used. The properties of the protein synthesized were studied. Immunological methods failed to demonstrate the presence of γ-globulin. Author

N67-17615*# National Aeronautics and Space Administration, Washington, D. C.
SOME CHARACTERISTICS OF METABOLISM AND CONDITIONED REFLEX ACTIVITY OF ANIMALS DURING PROLONGED STAY IN A HELIUM–OXYGEN MEDIUM [O NEKOTORYKH OSOBENNOSTYAKH GAZOOBMENA I USLOVNOREFLEKTORNOY DEYATEL'NOSTI ZHIVOTNYKH PRI DLITEL'NOM PROBYVANII V GELIO-KISLORODNOV SREDE]
G. V. Troshikhin Dec. 1966 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 169, no. 6, 1966 p 1480–1482
(NASA-TT-F-10617) CFSTI: HC $3.00/MF $0.65 CSCL 06F

Experiments were conducted with SS57, sexually-mature mice in air-tight chambers with controlled temperature and controlled helium–oxygen content (21 and 79%, resp.). When the temperature was 21–23°, the metabolism of the mice in the helium–oxygen atmosphere increased by 50% above the initial level during the first three days. The O_2-consumption decreased later but was always 10–15% above the controls (air atmosphere). Body temperature was decreased by 0.5–1.0° in the experimental animals. Both O_2-consumption and body temperature normalized when the animals were changed to the plain air atmosphere. Conditioned reflexes set in much more slowly in the experimental animals (as tested by the formation of a defensive conditioned reflex to white light). The mechanisms postulated are based on the heat conductivity of helium being 6 times that of nitrogen. Author

N67-17602*# Naval Air Engineering Center, Philadelphia, Pa.
GENERAL INTRODUCTION AND METHODS
Kenneth R. Coburn *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 1–11 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Overall aids and general methods are discussed for a program to determine at what point on a hypothetical pO_2 versus time curve oxygen would begin to limit rather than optimally sustain human physiological processes. Six aviators who had volunteered for astronautics duty were confined for a period of 34 days, with 20 days (days 8–27) at an altitude of 27,000 ft on 100% oxygen environment obtained from a liquid derived system. Prior to the oxygen environment experiment, the six aviators as well as two control subjects were given intensive training; and baseline physiological and psychological data were obtained on all eight men. During the latter half of the experiment, both test and control subjects donned pressurized suits; for the experimental group, days 15 through 27 were spent at the simulated high altitude and days 28 through 34 were at sea level. M.W.R.

N67-17603*# Naval Air Engineering Center, Philadelphia, Pa.
GENERAL DISCUSSION OF RESULTS AND CONCLUSIONS
Kenneth R. Coburn *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 13–16 ref (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Aside from the inverse relationship between retinal blood vessel caliber and pO_2, no positive findings are reported for six men confined to a 100% oxygen environment for 20 days. The wide variation in creatinine levels is attributed to technical difficulties, probably in urine collection. Variations were not any more marked in one subject who deliberately, although surreptitiously, lost 15 lb than in the other subjects who showed no significant weight changes. General buildup of microorganisms on the subjects posed no special problem; but since *Shigella Poly B, Bethesda Ballerup*, a coagulase-positive phage typeable staphlococcus, was isolated during the experiment, the need to eliminate all potentially pathogenic organisms from each member of a space crew is stressed. During debriefing, the most common complaint from the subjects was the ratio of temperature/humidity; and it is noted that the four different suits used had no common thermal characteristics. Flaking of skin is mentioned because it occurred in quantities sufficient to impair gas flow through the filters and to litter the living compartment floor. M.W.R.

N67-17604*# Naval Air Engineering Center, Philadelphia, Pa.
RETINAL VASCULAR RESPONSE TO OXYGEN AT INCREASED PARTIAL PRESSURES
Talvaris Turaids and Kenneth R. Coburn *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 17–23 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Retinal photographs taken after subjects had been breathing 100% oxygen at sea level for 5 to 30 min show a decrease of approximately 17% in caliber of arteries and 20% in veins. A 6 to 8% decrease in the diameter of retinal veins and arteries observed 5 to 30 min after ascent to 27,000 ft while breathing pure oxygen remains essentially the same after 19 days at this altitude. Smaller vessels decrease proportionately more than larger ones; and it appears that the increase in blood oxygen transport during hyperbaric oxygenation more than compensates for the reduction in retinal blood flow due to vasoconstriction. It is suggested that vasoconstriction in response to increased partial pressures may not be limited to the retina. M.W.R.

N67-17606*# Naval Air Engineering Center, Philadelphia, Pa.
RENAL FUNCTION AND WATER BALANCE
Talvaris Turaids *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 25–33 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Daily water intake and urine output are tabulated for the eight subjects who participated in the pure oxygen environment experiment; and serum and urinary creatinine and creatinine clearance are given for nine of the days during the experiment and the day after its completion. Average water usage, excluding that used for personal hygiene, was 1732 ml per man day; and the average water available to the body from all sources, including preformed water in the food and water of oxidation, was 2048 ml per man day. Water excreted from the kidneys and in feces averaged 1110 ml. If it is assumed that the subjects were in a state of normal water balance, there would be an insensible water loss of 938 ml per man day; and this is in good agreement with sea level loss which is estimated at about 900 ml. Because the creatinine data vary excessively from day to day, the collection means and the accuracy of the data are questioned. M.W.R.

N67-17608*# Naval Air Engineering Center, Philadelphia, Pa.
BLOOD STUDIES
Gary L. Kellett and Kenneth R. Coburn *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 35–57 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Mention is made of the large number of mercury-containing instruments broken inside the chamber during the pure oxygen environment experiment. Since stippled red cells were noted in the blood of the subjects, a toxic agent such as mercury vapor may have been involved. The average hematrocrit of the subjects varied no more than 2.5%; and red blood cell count corresponded closely to the averaged hematocrit, with essentially no changes before and after oxygen exposure and between test subjects and controls. Hemoglobin concentration showed an initial climb that was roughly parallel for subjects and controls during the first week of confinement; and a drop noted during the onset of the oxygen environment was followed by a moderate rise during the week following return to sea level conditions. While values for the experimental subjects are below those for the controls, all of the values are considered to be within normal limits. M.W.R.

N67-17607*# Naval Medical Research Inst., Bethesda, Md.
BIOCHEMICAL EFFECTS OF PROLONGED EXPOSURE TO AN ATMOSPHERE OF 100% OXYGEN AT A SIMULATED ALTITUDE OF 27,000 FEET
Lawrence J. Jenkins, Jr. and Robert Van Reen *In* Naval Air Eng. Center Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 59–71 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Biochemical data indicate that a 100% oxygen environment at a simulated altitude of 27,000 feet causes no injury to healthy humans. Activities of serum isocitrate dehydrogenase as well as erythrocytic glucose-6-phosphate dehydrogenase remained constant throughout the 20-day exposure and did not deviate from either baseline or control levels. No deviations are noted for serum haptoglobin as evidenced by its ability to bind hemoglobin, or in its relative distribution of serum lipoproteins between alpha and beta fractions. All of the subjects in this study had normal hemoglobin types. M.W.R.

N67-17608*# Naval Air Engineering Center, Philadelphia, Pa.
PULMONARY FUNCTION AND X-RAY
Donald W. Dery, Talvaris Turaids, and Kenneth R. Coburn *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 73–84 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Healthy young men exhibit no significant alterations in pulmonary function from exposure to 100% oxygen at 258 mm Hg pressure for 20 days according to measurements of tidal volume, expiratory reserve volume, inspiratory capacity, vital capacity, functional residual capacity, and carbon monoxide diffusing capacity. While tidal volumes appear to be high, they were taken during activities involved in food preparation and body hygiene maintenance. The loss noted in vital capacity is so slight that present techniques and instrumentation cannot verify if it is due to anatomic or functional change. Carbon monoxide diffusing capacity values are high normal and within the limits of experimental error; and no difference is seen between pre- and post-altitude values. Chest X-rays taken on the 26th day showed no changes from those taken two weeks prior to the study; and a harmless osteoma on a rib of one of the test subjects remained unchanged. M.W.R.

N67-17609*# Naval Air Engineering Center, Philadelphia, Pa.
SOME PSYCHOLOGICAL MEASURES ON SIX MEN CONFINED 24 DAYS IN A SEALED CABIN
Thomas D. Hanna *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 85–114 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Individual and group performance appear to be affected slightly by 24 days of confinement, independent of the oxygen concentration, the simulated altitude, or the use of the full pressure suit by 6 healthy subjects. Errors do not increase and correct responses do not decrease; and, although there are individual differences, the total number of daily errors is fairly constant. Fewer errors are exhibited on day than on night shifts, but it is speculated that this may be due to the subjects involved rather than the time of the experiment. The increase in difference between estimates and correct responses with time is noted; and this finding, defined as the level of aspiration, is evidenced in both individual and group performance. The accumulated data demonstrate no marked deterioration in group cohesiveness, individual performance, level of aspiration, goal seeking behavior, or leadership. M.W.R.

N67-17610*# Naval Air Engineering Center, Philadelphia, Pa.
CHANGES IN THE FREQUENCY DISTRIBUTION OF MUSCLE ACTION POTENTIALS FOLLOWING THE ACQUISITION OF A SIMPLE MOTOR SKILL (MIRROR TRACING)
Sherwin J. Klein and Malcolm M. Cohen *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 115–126 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Observed changes in frequency distribution of muscle action potentials suggest that precision of performance in a motor task is associated with the frequency-intensity characteristics of the emitted muscle action potentials. The acquisition of a motor skill may be associated with increased activity of higher frequency action potential components of the performing muscles. For five days prior to the 34-day confinement, the subjects attempted to trace the outlines of five different geometric forms with an electrified stylus. Each of the forms was traced for a 3-min period while the subject viewed both the form and the tracing hand in a mirror. Muscle action potentials were recorded during this period, but not during the 34-day experiment when the tracing task continued. Additional tracings were made for five days following confinement, and again potentials were recorded. Progressively fewer errors per trial were made with increasing practice, although a slight rise in total number of errors is evidenced in the post-confinement period. M.W.R.

N67-17611*# Naval Air Engineering Center, Philadelphia, Pa.
CURVATURE AFTER-EFFECTS AS A FUNCTION OF THE MAGNITUDE OF CURVATURE OF THE INSPECTED MATERIAL
Malcolm M. Cohen *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 127–138 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

A specially-constructed apparatus was used to present test subjects with lines of different degrees of curvature; and the apparent curvatures of lines were measured both before and after each exposure by means of a nulling procedure. The six subjects were exposed to the lines through a prism set at each of seven dioptric powers, with a period of at least one day between each exposure for each subject; and the subjects were required to make their own adjustments to designate apparent straightness before and after exposures. The magnitude of the curvature after-effect is a monotonic increasing function of the magnitude of curvature of the inspected material. Previous results had indicated that the magnitude of the after-effect was independent of the magnitude of curvature of the inspected materials, and the difference observed in the magnitude of curvature after-effect as a function of altitude is considered perplexing. M.W.R.

N67-17612*# Naval Air Engineering Center, Philadelphia, Pa.
THE EFFECTS OF STRESS PRODUCED BY CONFINEMENT IN SMALL GROUPS
James A. Asgard *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 139–210 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Effects of a one-month confinement on verbal learning, group cohesiveness, motivation, and time estimation were investigated. To study verbal learning and affective change, paired associates of

nonsense syllables were presented to subjects, who were later required to recall the words associated with each syllable. While it was expected that affective words would be recalled better than neutral words and that there would be a decrease in tissue resistance when they were spoken; none of these results were confirmed, although certain potentially affective words did acquire some effect as a result of confinement stresses. Group cohesiveness did not change significantly; the subjects did overestimate their group cohesiveness, but they were accurate in their perception of changes in interpersonal relationships. Hand Dynamometer results revealed an overall increase in peak force emission level; daily questionnaires indicated that the subjects had some insight into the symptoms produced during the study; and there was no significant correlation between manifest anxiety and underestimation of time intervals. M.W.R.

N67-17613*# Republic Aviation Corp., Farmingdale, N. Y.
EFFECT OF DIET AND ATMOSPHERE ON INTESTINAL AND SKIN FLORA Summary Report
Lorraine S. Gall and Phyllis E. Rielly *In* Naval Air Eng. Center Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 211–236 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Types and summarized of microorganisms present and frequency of their occurences in six body areas of six men subjected to certain simulated space flight conditions were compared to that of two control subjects. The conditions imposed during the experiment did not appear to create microbiological hazards; and, although a buildup of bacteria did occur on body areas and in the chamber, this buildup levelled off and was generally not considered to be pathogenic. After the subjects had eaten the experimental diet for several days, the predominating fecal flora were heavy gas-formers that might produce increased flatulence. Bacterial buildup in the wash water and on the neck of the urine bottle was caused by generally undesirable types of bacteria, and the pressure suits had many residual microorganisms of the type associated with the human body. Details of sampling collecting and culturing are included. M.W.R.

N67-17614*# Naval Air Engineering Center, Philadelphia, Pa.
NUTRITION AND BALANCE
Gary L. Kellett *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 237–249 refs (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

The NASA supplied freeze-dehydrated diet was found to be acceptable for a period of at least 34 days; and biochemical analysis of excretory products along with the balance studies exhibited variations considered to be within acceptable limits. Ease in food preparation is noted; and preparation procedures were left up to the individual subjects, who developed a system whereby one man did the weighing and the other added the water and mixed the dehydrated material. The majority of the subjects were highly satisfied with the tastiness and general esthetic qualities of the food; and the general consensus was that taste improved as subjects became used to the food. M.W.R.

N67-17615*# Naval Air Engineering Center, Philadelphia, Pa.
FULL PRESSURE SUITS AND PERSONAL HYGIENE
Gary L. Kellett, Talvaris Turaids, and Kenneth R. Coburn *In its* Physiol., Psychological, and Bacteriol. Aspects of 20 Days in Full Pressure Suits Feb. 1967 p 251–254 (See N67-17601 07-05) CFSTI: HC $3.00/MF $0.65

Apollo, Mark IV and V, and Mercury X pressurized suits seem to be acceptably comfortable for a 20-day period. While all of the suits were constantly ventilated at 60°F and had individual adjustments to regulate flow up to 12 liters/minute, they lacked adequate ventilation with the helmets and gloves off. This probably caused athlete's foot on one subject, pustules on another, and tinea cruris in a third; but these skin reactions cleared rapidly with minimal treatment. Shedding of superficial skin layers may result from lack of body hygiene, and probably would have occurred without the use of the full pressure suits. Subjects felt they remained relatively comfortable as long as they could wash their faces and brush their teeth. They preferred wash cloths to chemically treated hygiene pads, even though the cloths became dirty and malodorous after a few days of use. Growing of beards posed no problem; rather they were considered a morale booster, since they could be compared for length and bushiness each day. M.W.R.

N67-17630*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES, DECEMBER 1966
Jan. 1967 158 p refs
(NASA-SP-7011(32)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Biological, physiological, psychological, and environmental effects of simulated or actual flight in the earth's atmosphere or in interplanetary space are covered in the continuing bibliography entitled *Aerospace Medicine and Biology*. Annotated references are included for all the unclassified reports and journal articles in these subject categories that were introduced into the NASA information system during December 1966. M.W.R.

N67-17667# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STATUS AND PERSPECTIVES OF DEVELOPING INVESTIGATIONS IN BIOLOGICAL CYBERNETICS AT THE ACADEMY OF SCIENCES UKR–SSR
27 Jun. 1966 8 p Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 3, 1965 p 389–390
(FTD-HT-66-192; AD-643705) CFSTI: HC $3.00/MF $0.65

Translation of Russian article: The status and perspectives of developing investigations in biological cybernetics at the Academy of Sciences UKR–SSR. TAB

N67-17675# School of Aerospace Medicine, Brooks AFB, Tex.
LONG-TERM EFFECTS OF AN OXYGEN ENVIRONMENT ON A RAT COLONY AT 210 MM. Hg ABSOLUTE Final Report, Nov. 1964–Nov. 1966
William E. Pepelko Oct. 1966 13 p refs
(SAM-TR-66-90; AD-642748) CFSTI: HC $3.00/MF $0.65

Twelve female, albino rats (Charles River CD®) were exposed for a period of 11 months to an environment containing near 100% oxygen at a total pressure of 210 mm. Hg absolute. Growth rates, length of pregnancy, size of litters, and number in each litter weaned did not differ significantly from ground-level controls. Offspring of altitude females either remained at altitude or were brought to ground level at 21 days of age. All F1-generation animals were sacrificed at 60 days of age. Growth rates of altitude animals and altitude animals brought down at 21 days of age did not differ significantly from those of ground-level controls, nor did eosinophil and reticulocyte counts, hemoglobin, hematocrit, or white and red cell counts with one exception: Control males exhibited a higher red cell count than males born at altitude, but brought down at 21 days of age. It was concluded that the environmental conditions resulted in no important physiologic changes to the animals even over long periods of time and that readaptation to ground-level conditions occurred with no apparent difficulty. Author (TAB)

N67-17679# College de France, Paris. Institut Marey.
NERVOUS PROCESSES UNDERLYING BEHAVIOR AND LEARNING Final Scientific Report, 1 May 1965–30 Apr. 1966
A. E. Fessard 30 Apr. 1966 18 p refs
(Grant AF-EOAR-65-34)
(AFOSR-66-2356; AD-640861) CFSTI: HC $3.00/MF $0.65

An analytical study of communication structures and basic mechanisms which will provide a better understanding of how the brain controls well-defined performances of animal behavior. Material is categorized under the headings: animal behavior, cerebral physiology, and cellular processes. TAB

N67-17717# School of Aerospace Medicine, Brooks AFB, Tex.
RECOVERY OF CLOSTRIDIA FROM HUMAN FECES. DEVELOPMENT OF A METHOD, SEPTEMBER 1965-JANUARY 1966
Charles Eller Sep. 1966 14 p refs
(SAM-TR-66-81; AD-643819) CFSTI: HC $3.00/MF $0.65

A method allowing consistent recovery of clostridia from human feces is presented. During development of this procedure, clostridia were isolated in 105 of 161 specimens. Maximal dilution at which isolations were obtained varied from .001 to 10 to the minus 9th power, with a median of .00001. Diet was without effect. The final procedure employed heated dilutions of .01, .001, and .0001 with blood agar and sulfite-polymyxin-sulfadiazine (SPS) agar. Unheated dilutions were .00001, .000001, and 10 to the minus 7th power with blood agar and .0001, .00001, and .000001 with SPS agar. Clostridia were isolated from 20 to 21 samples. On the basis of morphology, 312 clostridial isolates were divided into seven groups. The most frequent type consisted of slender rods with terminal spores. By streaking heated suspensions to blood agar, C. perfringens was recovered from 20 of the 161 samples. Media used by others are discussed, and the usual fecal clostridia are listed. Author (TAB)

N67-17723# Royal Aircraft Establishment, Farnborough (England).
INVESTIGATIONS ON THE PHYSIOLOGICAL MOVEMENTS OF AMOEBA CHAOS CHAOS L. PART II: THE ACTION OF SALYRGAN, CYSTEINE AND ADENOSINE TRIPHOSPHATE [BEWEGUNGSPHYSIOLOGISCHE UNTERSUCHUNGEN AN DER AMOEBA CHAOS CHAOS L. II: DIE WIRKUNG VON SALYRGAN, CYSTEIN UND A.T.P.]
Werner Kappner May 1966 36 p refs Transl. into ENGLISH from Protoplasma (Vienna), v. 13, no. 4, 1961 p 504-529
(RAE-LIB-TRANS-1164) CFSTI: HC $3.00/MF $0.65

The study showed that salyrgan inhibits the contraction of the amoeba's membrane, promotes the relaxation of the membrane and the liquefaction of the plasmagel, causes the cytoplasm crystals to cluster together, and increases the number of empty vacuoles. Cysteine was found to suspend the action of salyrgan and to promote the amoeba's ability to contract and the tendency for its fibers and strands to fold together. ATP brings about contraction and has a plasticizer effect. The reaction which sets in with ATP was found to be dependent on the physiological state of the amoebae at the time. R.N.A.

N67-17732# California Univ., Livermore. Lawrence Radiation Lab.
MODELING THE CHROMOSOME
Roger G. Hart 3 Jan. 1966 18 p refs
(Contract W-7405-ENG-48)
(UCRL-14625, Rev. 1) CFSTI: HC $3.00/MF $0.65

An attempt was made to model the chromosome with respect to its structure and its function insofar as both are known. To this end, a hypothetical scheme was developed for the replication of chromosomal DNA in agreement with the results of tracer studies and with known capabilities of DNA polymerases. In keeping with the replication scheme, each double-helical DNA molecule is postulated to be bent into a loop with its ends held together by the association of two linking proteins covalently bonded to the DNA. A third linking protein is bonded to the DNA molecule near its middle. The chromosome is envisioned as a long sequence of such DNA loops, with the two end-linking proteins of each loop associated with the middle-linking protein of the next loop in the series. Other aspects of the chromosome considered in this model are: control of messenger synthesis, which is attributed to gating proteins situated on the DNA at the sites where transcriptions begin, and to a coordinated histone-shifting mechanism that masks or unmasks the DNA templates; prophase contraction, which is explained as a supercoiling of the DNA loops, again caused by a systematic shift of histones; and crossing over, which results from misplacement of end-linking proteins during synapsis. Some genetic consequences of a loop-sequence chromosome model have already been considered by Stahl, whose work is cited. Author (NSA)

N67-17737# California Univ., Livermore. Lawrence Radiation Lab.
ION BINDING PROPERTIES OF HUMAN SERUM LIPOPROTEINS
William Lewis Robison (Ph.D.—Calif. Univ., Berkeley) 6 Jan. 1966 68 p refs
(Contract W-7405-ENG-48)
(UCRL-14631) CFSTI: HC $3.00/MF $0.65

Certain anion and cation binding properties of the serum lipoproteins HDL_3 and LDL (S_f 3–9) were studied. The protein moiety of the HDL_3 was also studied for comparative purposes. The binding studies were accomplished by using the equilibrium dialysis technique. Both the HDL and LDL showed a considerable capacity for binding the selected anion methyl orange. The binding per mole exceeded that of serum albumin, which had previously been thought to be the only serum protein with such a capacity. Even among nonserum proteins which were studied this was an uncommon property. The LDL had a greater binding capacity than the HDL_3 when considered on a molar basis, when considered in terms of total protein, and when considered in terms of total protein plus phospholipide available. The LDL showed a multiple-site type of binding curve now observable with the HDL_3 over the concentration range studied. The protein moiety of the HDL did bind the anion methyl orange but at a much reduced strength and capacity. This was interpreted to indicate additional stability imparted to the binding process by the lipides through nonpolar forces. The serum lipoproteins representing certain types of lipoprotein complex showed a very low capacity for binding the cations Ca and Mg. The association constants are of the order of 10^3 or about the same as other protein systems such as albumin. This is much below that reported for some membranes which are lipide–protein in character, and possible reasons for the differences are discussed. NSA

N67-17748# Connecticut Univ., Storrs. Dept. of Statistics.
ROBUSTNESS OF THE STUDENT-PROCEDURE: A SURVEY
Lawrence O. Hatch and Harry O. Posten Aug. 1966 70 p refs
(Contract Nonr-3292(03))
(RR-24; AD-643494) CFSTI: HC $3.00/MF $0.65

The paper surveys the approaches and results of various investigations of the effects of deviations from assumptions when the Student-procedure is used to test hypotheses on means (i.e. t-tests). It is an attempt to provide a complete summary of the literature including both theoretical and empirical studies. At the same time, it also provides a study of the general techniques used to investigate the robustness of other statistical procedures since these techniques are similar to those used for the Student-procedure. Author (TAB)

N67-17756# Army Biological Labs., Fort Detrick, Md.
INFLUENCE OF THE IONS OF TRIVALENT IRON ON THE PHYSICAL-CHEMICAL PROPERTIES OF SOLUTIONS OF NATIVE DESOXYRIBONUCLEIC ACID
A. N. Ilina, V. D. Zhdanova, Yu. Sh. Moshkovskiy, and S. Ya. Mirlina Jan. 1966 13 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 10, no. 6, 1965 p 929–934 /ts Transl. No. 1745
(AD-642071; TT-67-60031) CFSTI: HC $3.00/MF $0.65

An investigation was made on the influence of the addition of Fe(3+) on the viscosity, dispersion curves of optical rotation and the absorption spectra of solutions of native DNA. It was shown that with the formation of a complex of DNA with Fe(3+) a lessening takes place in the values of the quoted viscosity in a wide range of concentrations of DNA. In the presence of Fe(3+ ions an increase is observed in the value of the specific rotation and a decrease in the absorption coefficient of solutions of DNA, and also an increase of the melting temperature in comparison with the melting temperature of pure DNA. The experimental data obtained agree with the model of a macromolecule of DNA, having a certain number of points at which there is the possibility for the rotation of parts of the molecule which are stable rods. The addition of Fe(3+) ions leads to an increase in the rigidity of the DNA macromolecule, by reducing the number of places around which a bending of the macromolecule takes place. Author (TAB)

N67-17761*# Miami Univ., Coral Gables, Fla. Research and Teaching Center of Toxicology.
FLUORINE TOXICITY STUDIES AT THE UNIVERSITY OF MIAMI Semiannual Progress Report
M. L. Keplinger 30 Nov. 1965 11 p
(Grant NGR-10-007-012)
(NASA-CR-69992) CFSTI: HC$3.00/MF$0.65 CSCL 06F

Air in an exposure chamber of stainless steel was analyzed for fluorine concentration by use of gas-liquid chromatography. Wet methods for measurement of fluorine and fluoride were also used. As expected, signs of intoxication from high concentrations of fluorine in air were marked irritation of the mucous membranes of the eyes and respiratory tract. The skin of the animals showed very little irritation at the concentrations used. The LC_{50} (concentration calculated to kill 50% of the animals) was determined for exposure in rats, mice, guinea pigs, and rabbits. A table of the values shows very little difference between the LC_{50}'s of the different species. At lower concentrations there were fewer signs of intoxication. Dyspnea, lethargy, red nose, and swollen eyes were observed at concentrations equivalent to 50% of the LC_{50}'s. Complete blood counts on the animals did not show significant changes, however the clotting time appeared to be slower than normal. S.P.

N67-17765*# Florida State Univ., Tallahassee. Dept. of Statistics.
ESTIMATION FOR A SIMPLE EXPONENTIAL MODEL
Janace A. Speckman (Natl. Bur. of Std.) and Richard G. Cornell 24 Feb. 1966 28 p refs Submitted for Publication
(Grant NGR-10-004-029)
(NASA-CR-70495; TR-3) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Methods of estimating the parameter in a simple exponential model, which often arises in epidemiological studies and biological assay, are presented. The method of maximum likelihood is known to have desirable large sample properties and behave well in the limited Monte Carlo study. The simple method of partial totals is suggested as a possible alternative to maximum likelihood for small samples for equally spaced doses. The Fisher and Spearman methods, which are also computationally easy, are proposed as alternative methods regardless of the sample size for exponentially spaced dosages, that is, for dosages whose logarithms are equally spaced. S.P.

N67-17767*# Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
EFFECT OF WATER PROPERTIES IN THIXOTROPIC CLAY SYSTEMS ON BIOLOGICAL ACTIVITY Annual Report, 1966
Philip F. Low [1966] 11 p
(Grant NGR-15-007-004)
(NASA-CR-70970) CFSTI: HC$3.00/MF$0.65 CSCL 06C

Results are reported for various microcalorimeter experiments, studies to measure the relative partial molar free energy of water in clay soils and gels, and investigations to determine the minimum clay concentration at which gelation occurs in a clay-water suspension. In order to study the effect of changes in water properties in a clay system on biological activity, a culture was introduced into two suspensions having the same clay content. Results of experiments with heats of germination on individual systems suggest that water properties are different in clay sols then in clay gels, and that biological activity is influenced by this difference. S.P.

N67-17880*# California Univ., Berkeley. Space Sciences Lab.
SPECIFIC NATURE OF HYDROLYSIS OF INSULIN AND TOBACCO MOSAIC VIRUS PROTEIN BY THERMOLYSIN
H. Matsubara, R. Sasaki, A. Singer, and T. H. Jukes [1965] 26 p refs Submitted for Publication
(Grant NsG-479)
(NASA-CR-70649) CFSTI: HC$3.00/MF$0.65 CSCL 06A

Oxidized bovine insulin and tobacco mosaic virus protein were used as substrates in an investigation of the specificity of thermolysin, a thermostable protease. Thermolysin hydrolysed the peptide bonds involving the amino-groups of leucine and phenylalanine residues of insulin under the conditions used, and preferentially those of leucine, isoleucine, valine and phenylalanine residues of tobacco mosaic virus, protein. It was concluded that thermolysin hydrolyses preferentially the peptide bonds involving the amino-groups of hydrophobic amino acid residues with bulky side chains. Author

N67-17887# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
RADIATION DOSIMETRY FOR RADIATION PROTECTION
W. C. Roesch 9 Aug. 1966 18 p Presented at Conf. on Principles of Radiation Protect., Oak Ridge, Tenn.
(Contract AT(45-1)-1830)
(BNWL-SA-616; CONF-660815-1) CFSTI: HC$3.00/MF$0.65

Development of concepts used in describing radiation fields and their interactions with matter are described. Modification of the basic concepts of radiation dosimetry to fit the primary goals of radiation protection are discussed. It is suggested that some physical quantity other than adsorbed dose might give a closer correlation with biological effects than does dose. Hence, other methods of correlating dose with biological effects were evaluated, including: the use of momentum to supplement or replace energy in correlating biological effects; relating the probabilities of biological effects to the mean LET; and measurement of individual absorbed energies with a proportional counter made of tissue-equivalent materials and applying the theory of irradiated media of uniform composition but varying density to establish that the deposition of energy in the counter is the same as that in a solid biological entity of the same shape but smaller in size of the ratio of the gas density in the counter to the density of the solid. NSA

N67-17926 Royal Aircraft Establishment, Farnborough (England).
INVESTIGATIONS ON THE PHYSIOLOGICAL MOVEMENTS OF AMOEBA CHAOS CHAOS L. PART I: THE INFLUENCE OF THE pH OF THE MEDIUM ON THE PHYSIOLOGICAL MOVEMENTS OF AMOEBA CHAOS CHAOS L [BEWEGUNGSPHYSIOLOGISCHE UNTERSUCHUNGEN AN DER AMOEBA CHAOS CHAOS L. 1. DER EINFLUSS DES pH DES MEDIUM AUF DAS BEWEGUNGS-PHYSIOLOGISCHE VERHALTEN VON CHAOS CHAOS L]
Werner Kappner May 1966 41 p refs Transl. into ENGLISH from Protoplasma (Austria), v. 13, no. 4, 1961 p 81-105
(RAE-LIB-TRANS-1163) CFSTI: $3.00

Varying pH values were determined in an investigation of the causes of Amoeba Chaos chaos L physiological movements. It was found that with decreasing pH the number of simultaneously existing pseudopodia also decrease, as shown by a shift to the left of the distribution curves, indicating pseudopodia numbers. The

formation of pseudopodia follows definite known laws, and the numerical possibility of its formation is limited with falling pH. It was also seen that the formation of pseudopodia is preceded by a damming up of the cytoplasm resulting from a contraction wave. The contraction wave movement begins at the anterior end as a lateral deflection to the longitudinal direction. R.U.

N67-17930# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Inst.

CLINICAL AVIATION MEDICINE RESEARCH: COMPARISON OF SIMULTANEOUS MEASUREMENTS OF INTRA-AORTIC AND AUSCULTATORY BLOOD PRESSURES WITH PRESSURE-FLOW DYNAMICS DURING REST AND EXERCISE

Francis J. Nagle, John Naughton, and Bruno B. Balke Oct. 1966 14 p refs

(Grant PHS-G-HE-06286-04)

(AM-66-36) CFSTI: HC $3.00/MF $0.65

Two healthy men, 40 and 57 years of age, underwent right-sided cardiac catheterization and retrograde supra-aortic catheterization (1) to compare direct intra-aortic blood pressures with those recorded simultaneously by auscultation of the brachial artery; and (2) to study the pattern of pressure and flow dynamics during bicycle work at moderate strenuous and maximal intensities. In most instances systolic pressures measured by auscultation were in close agreement with the directly recorded measurements. The indirectly measured diastolic pressures were consistently higher than the directly recorded values in one subject and they were consistently lower than the directly measured diastolic pressures for the other subject. Neither the muffling nor the cessation of sound could be closely identified with minimal intra-aortic pressures. Systolic and mean pressures, minute flow, stroke volume and a-v oxygen difference increased with greater work intensities. Author

N67-17934# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Inst.

PROBLEMS IN AERIAL APPLICATION: A COMPARISON OF THE ACUTE EFFECTS OF ENDRIN AND CARBON TETRACHLORIDE ON THE LIVERS OF RATS AND OF THE RESIDUAL EFFECTS ONE MONTH AFTER POISONING

George Clark Jul. 1966 11 p refs

(AM-66-34) CFSTI: HC $3.00/MF $0.65

Since the liver damage induced by carbon tetrachloride poisoning has been extensively studied, it was thought that a comparison of the effects on the liver of carbon tetrachloride and of endrin would serve to partially elucidate this problem. Rats poisoned with either endrin or carbon tetrachloride were studied in the acute stage and after a one month recovery period. With endrin, fat was deposited perilobularly in relatively fine droplets. RNA was diffused perilobularly and was in clumps elsewhere and the density of the Weil strain was increased in acutely poisonec rats. By contrast, the fat was centrolobular in CCl_4 poisoned animals, there was little change in RNA except for its absence in necrotic cells and the density of the Weil stain was only slightly greater than in the controls. In the one month recovery period, all changes seen in the acute animals virtually disappeared and histologically the livers were almost normal. Author

N67-17950# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE PRESENCE OF TWO LIGHT-DEPENDENT ENZYMATIC PROCESSES ACCOMPANYING FLUORESCENCE DECAY IN WHEAT LEAVES DURING PHOTOSYNTHESIS

Pei-Chien Chow, See-Ching Lin, Zhung-Chee Chu, Ko-Fa Shien, and Pei-Sung Tang 15 Jun. 1966 12 p refs Transl. into ENGLISH from Chih Wu Hsueh Pao (Peking), v. 12, no. 1, 1964 p 82-87

(FTD-TT-65-1091; TT-66-62342; AD-639459) CFSTI: HC $3.00/MF $0.65

The leaves of wheat sprouts (Agricultural University variety 183) were used as the object of experimentation, and the variation of the time curve of chlorophyll fluorescence during the initial period of illumination was determined. Under the influence of various temperatures, fluorescence decay was found to be hastened by increasing temperatures within a definite range; in addition, there was the phenomenon of a later fluorescence intensity increase known as the second rise. The occurrence of the second rise has a definite relation to temperature; fluorescence decay disappears after a 10-minute treatment at a temperature of 45°C; after decay, leaves can recover fluorescence intensity in darkness, the degree of restoration being directly proportional to the period of time in darkness. The following results were obtained from the inhibitor experiments: sodium azide, potassium cyanide and DNP have little effect on the first rise, but an inhibitory effect on the second rise; malonate greatly affects the decrease of the first rise, but altogether lacks inhibitive effect on the second rise; succinate and fumarate have a restoring effect on the inhibition by malonate. It is possible that the decrease of the first rise has a definnte relation to the tricarboxylic acid cycle, whereas the second rise may have something to do with the cellular pigmentation system and phosphorylation. Author (TAB)

N67-17964*# School of Aerospace Medicine, Brooks AFB, Tex.

ECOLOGIC RELATIONSHIPS BETWEEN BACTERIA AND ALGAE IN MASS CULTURE

C. H. Ward and J. E. Moyer [1966] 29 p refs Presented at the Conf. on Bioregenerative Systems, Washington, 15-16 Nov. 1966; Sponsored by Am. Inst. of Biol. Sci. and NASA

(NASA Order R-99)

(NASA-CR-81668) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Mass cultures of algae grown without strict maintenance of axenic conditions readily become contaminated with heterotrophic bacteria. Contaminant populations from 10^6 to 10^9 viable cells per ml of algal culture are frequently encountered. Only a limited number of bacterial forms occur in large numbers in mass cultures of *Chlorella*. Soil, air, and putrefactive bacteria generally do not survive in algal cultures; however, two species of an enteric pathogen grow well for prolonged periods. Several bacteria significantly decrease the growth of *Chlorella*, but their effects are non-additive and apparently non-parasitic in nature. Filtrates of axenic algal cultures support prolific growth of contaminant bacteria. Dialyzable organic materials excreted by algae during growth serve as the major source of nutrients for bacterial growth. Chromatographic analyses of axenic algal filtrates reveal a variety of organic acids, amino acids, and compounds of higher molecular weight. Author

N67-18005*# Naval School of Aviation Medicine, Pensacola, Fla. Aerospace Medical Center.

KINEMATICS NOMENCLATURE FOR PHYSIOLOGICAL ACCELERATIONS: WITH SPECIAL REFERENCE TO VESTIBULAR APPLICATIONS

W. Carroll Hixson, Jorma I. Niven, and Manning J. Correia 8 Aug. 1966 97 p refs Joint report with NASA *Its* Monograph 14

(NASA Order R-93)

(NASA-CR-81715) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A mathematical nomenclautre in the language of kinematics has been formulated to provide precise, man-referenced identifications of the real accelerations comprising the basic vestibular stimuli and of certain selected vestibular response measures. The system is based on establishing anatomical landmarks in the form of three mutually orthogonal cardinal head axes and planes to which the magnitude and direction characteristics of both the acceleration stimuli and the vestibular responses can be referenced. Notation is provided to describe separately the resultant linear acceleration and the resultant angular acceleration arising in any force environment in terms of their components acting along and about, respectively, the three cardinal axes. The notation and application format of the

nomenclature has application in the general acceleration physiology field as well as the vestibular area. Author

N67-18036*# California Univ., San Diego. Dept. of Chemistry.
A FEASIBILITY STUDY ON MINIATURIZING AN AUTOMATIC AMINO ACID ANALYZER FOR USE ON APOLLO MISSION AND MARS VOYAGER MISSION PROGRESS REPORT, JUN.–DEC. 1966
Stanley L. Miller, Joseph Kraut, and Karl M. Dus Dec. 1966 7 p
(Grant NGR-05-009-032)
(NASA-CR-81680) CFSTI: HC $3.00/MF $0.65 CSCL 06A

A flow diagram of a semi-micro amino acid analyzer is presented, and details are given on the redesign and development of several essential component parts. These include miniature rotary valves, the hydrolysis chamber, the reaction coil heating chamber, and the flow cell with a long light path. Attention is also being directed to the selection and arrangement of components for the spectrophotometric unit in order to achieve the greatest compactness and sensitivity. In considering the chemical aspects, a preliminary search was conducted for reagents which might prove superior to ninhydrin either because of high sensitivity or greater selectivity. Two such reactions, trinitrophenylation and dansylation, are considered promising. M.G.J.

N67-18081* Public Health Service, Phoenix, Ariz. Technology Branch.
MICROBIAL CONTAMINATION IN CONVENTIONAL AND LAMINAR FLOW CLEAN ROOMS
Martin S. Favero [1966] 11 p refs Presented at the 5th Ann. Tech. Meeting and Exhibit, Am. Assoc. for Contamination Control, Houston, Tex., 29 Mar.–1 Apr. 1966
(NASA Order R-137)
(NASA-CR-81751) CFSTI: $3.00 CSCL 06M

The accumulation of microorganisms on stainless steel strip surfaces exposed to the environments of various industrial clean rooms was investigated. Culture plates from the air, surface, and stainless steel strip samplings were picked and subcultured. The cultures were gram-stained, subjected to pertinent biochemical tests and identified. The objective of the study was to determine quantitatively and qualitatively the predominant types of microbial contaminaton found in conventional industrial clean rooms and in clean rooms which employ laminar air flow to control particulate contamination. Floor plan diagrams of the clean room areas used for the study are depicted. Tables of data on the levels of microbial contamination accumulation for the various rooms are given, and plots showing the effect of personnel density and activity on the level of airborne microbial contamination in the clean rooms, are depicted. L.S.

N67-18126*# George Washington Univ., Washington, D. C.
BIBLIOGRAPHY ON CLEAN ROOMS
Donald E. Wright Nov. 1966 64 p refs
(Contract NSR-09-010-027)
(NASA-CR-81783) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Contamination control technical details are provided through bibliographic information. Emphasis is on clean room operations for surgical instrumentation and electronics applications. Author and permuted title indexes are included. R.L.I.

N67-18127# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Dept.
[SCOPE OF WORK FOR SCIENTIFIC AND TECHNICAL ASSISTANCE FOR THE PLANETARY QUARANTINE MISSION] Quarterly Report, Period Ending Dec. 31, 1966
Dec. 1966 17 p
(NASA Orders R-09-019-040; H-13245A; W-12324)
(NASA-CR-81784; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 06M

In planetary travel contamination studies, the further investigation of a spacecraft sterilization model to decontaminate assayed microbial populations is reported. Equations and chemical reactions are briefly mentioned for technical analyses made during the reporting period. Other mission planning activities outlined include literature searching, and the cataloging of available information. R.L.I.

N67-18128 Illinois Univ., Chicago.
[NITROGEN CHEMISTRY SIGNIFICANT TO PRIMORDIAL SYSTEMS] Semiannual Report, 1 Jul.–31 Dec. 1966
Joseph H. Boyer 20 Jan. 1967 7 p
(Grant NGR-14-021-004)
(NASA-CR-81785; SAR-2) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Deoxygenation of benzoyl cyanide by a phosphine derivative and preparation of phenylnitrosoacetylene are reported in connection with the determining a resonance interaction or an equilibrium between cyanocarbenes and other research dealing with nitrogen chemistry and primordial systems is alkylnitrenes. Centered on the isometric alpha- and beta-phenylvinyl nitrenes, and is designed to elucidate the reaction that may require an intramolecular migration of a group or atom from an sp^2 carbon to an adjacent nitrene nitrogen. Two possible pathways for vinyl nitrenium cations to react with water are reported, and nitrenes are studied in which the nitrene nitrogen is attached to oxygen. In a study of o, o'-diazidobiphenyl, it is noted photolysis apparently leads to a monotrene rather than a nitrene. Preparation of diene isocyanates and their possible ring closure by valence isomerization is being investigated, as are methods for the preparation of nitroso azomethine derivatives. M.W.R.

N67-18129*# Syracuse Univ., N. Y. Biological Research Labs.
STUDIES ON TRACE ELEMENTS IN THE SPORULATION OF BACTERIA AND THE GERMINATION OF BACTERIAL SPORES Informal Semiannual Report, 1 Jun.–31 Dec. 1966
Ralph A. Slepecky 31 Dec. 1966 3 p refs
(Grant NsG-693)
(NASA-CR-81786) CFSTI: HC $3.00/MF $0.65 CSCL 06M

During bacterial spore germination investigations, previous studies on the Mn requirement, based on the additions of Mn to Mn deficient cells at various times of the growth cycle, were extended during this reporting period by measuring the Mn levels of the various cell stages. Current measurements of the Mn levels are made by the atomic absorption spectrophotometer (AAS). R.L.I.

N67-18130* Naval School of Aviation Medicine, Pensacola, Fla.
THE PROBLEM OF MAN'S GRAVITOINERTIAL FORCE ENVIRONMENT IN SPACE FLIGHT Quarterly Progress Report, 1 Oct.–31 Dec. 1966
Ashton Graybiel 31 Dec. 1966 5 p refs
(NASA Order R-93)
(NASA-CR-81787; PR-15) CFSTI: $3.00 CSCL 06S

Results of a motion sickness study conducted in a slow rotation room are presented. A table which shows a ranking of antimotion sickness drugs as determined by their effectiveness in altering susceptibility to symptoms is included. C.T.C.

N67-18131*# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Environmental Health Engineering.
INVESTIGATION OF BIOCHEMICAL STABILIZATION OF AQUEOUS SOLUTIONS OF ORGANIC COMPOUNDS BY UNSATURATED FLOW THROUGH POROUS MEDIA Semiannual Status Report
J. E. McKee 15 Nov. 1966 6 p
(Grant NGR-05-002-036)
(NASA-CR-81671; SASR-3) CFSTI: HC $3.00/MF $0.65 CSCL 06A

In order to develop cultures of bacteria capable of stabilizing ammonia to nitrates, 14 columns of 0.56-mm sand and 2 columns of 0.12-mm sand were ripened with settled municipal sewage. The finer sand was found unsuitable, but 10 of the 14 columns were placed on a urine feed with concentrations of 5 to 100% urine concentration. The columns at all dilutions have been almost 100% effective in destroying both urine and creatinine, but the end product has been ammonium rather than the nitrates expected. The pH values of the urine feed has varied from 5.9 to 6.3, while the value for the percolate has ranged from 8.5 to 9.3. Since urea is seldom presented in the percolate and the pH value has risen, it is evident that the conversion of urea to ammonium and bicarbonate ions is essentially completed in the columns. There has been no evidence of oxidation of Kjeldahl nitrogen to nitrates or nitrites in even the most undiluted columns; therefore, insufficient oxygen is not the only reason for ineffective nitrification. M.W.R.

N67-18138* California Univ., San Francisco. Biomechanics Lab.
RELATIVE ROLES OF GRAVITATIONAL AND INERTIAL WORK IN THE ENERGY COST AND CHARACTER OF HUMAN LOCOMOTION Semiannual Progress Report, 1 Jul. 1966–1 Jan. 1967
Henry J. Ralston 1 Jan. 1967 5 p
(Grant NsG-722)
(NASA-CR-81774) CFSTI: $3.00 CSCL 06P

Scientific advancements are reported on an analysis of human locomotion on the treadmill, and on the effects of loading the trunk of a human subject on the energy cost, character, and efficiency of locomotion. Graphed data indicate energy expenditure of each segment of the body, determined from stabilized oxygen consumption. Similar data are depicted for the same subject walking at uniform speed but carrying a 10 kg. load. Observations indicate that the principal factor in the change in energy cost of walking, subject to loading conditions, is the gravitational work performed. However, even under conditions of earth gravity the effects of loading the trunk to a limit approaching the subject's tolerance have a relatively small effect on the overall mechanical work performed and consequently upon the energy cost of doing the work. R.L.I.

N67-18139*# Public Health Service, Phoenix, Ariz. Technology Branch.
[RESEARCH ON MICROBIOLOGICAL STERILIZATION PROBLEMS] Quarterly Report, Oct.–Dec. 1966
18 Jan. 1967 23 p
(NASA Order R-137)
(NASA-CR-81775; Rept.-16) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The following work is reported: (1) development of a standard model system for evaluating the recovery of viable microorganisms from the interior of plastic, and experiments to determine the number of spores destroyed by the grinding technique as well as the number remaining in the plastic after grinding; (2) enumeration of microbial contaminants on surfaces, with tests to determine the effect of temperature on the recovery of *B. subtilis* var. *niger* spores from surfaces by ultrasonication; (3) evaluation of the efficiency and precision of the swab-rinse technique for assessing the levels of surface contaminants on lunar spacecraft; (4) studies on the recovery of sublethally injured microorganisms, in which tubes and stainless steel strips were inoculated with a suspension of *B. subtilis* var. *niger* spores and exposed to ethylene oxide followed by incubation; and (5) monitoring of microbial contamination at Cape Kennedy in hangars, in the Surveyor sterilization and assembly laboratory, the fuel loading room, in the Lunar Orbiter camera room, and in the Biosatellite clean room. Results are presented in tables. K.W.

N67-18163*# California Univ., Los Angeles. Brain Research Inst.
NEUROPHYSIOLOGICAL AND BEHAVIORAL STUDIES OF CHIMPANZEES Semiannual Report, 1 Jul.–31 Dec. 1966
J. D. French and W. R. Adey 6 Jan. 1967 7 p refs
(Grant NsG-502)
(NASA-CR-81667) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Considerable progress has been made on the chimpanzee program in the last six months. Computer control of the Matching to Successive Symbol Device (MSD) described in detail in previous reports is now being established in the new Space Science Center, and training of the chimpanzees on the device has begun. Author

N67-18165*# Harvard Univ., Boston, Mass. Thorndike Memorial Lab.
A STUDY OF PHYSIOLOGICAL MECHANISMS AND INTER-RELATIONS BETWEEN SYSTEMIC AND REGIONAL BLOOD VOLUME, BLOOD FLOW AND ELECTROLYTE BALANCE Interim Progress Report, Jul. 1–Dec. 31, 1966
Walter H. Abelmann and Laurence E. Earley 31 Dec. 1966 7 p refs
(Grant NsG-595)
(NASA-CR-81661) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Progress is reported in the following studies: (1) *Renal Hemodynamics and Sodium Excretion*—laboratory investigations in dogs demonstrated that tubular readsorption of sodium relates to the effectiveness with which renal perfusion pressure is transmitted along the intrarenal circulation; (2) *The Effect of Atrial Fibrillation upon Excretion of a Sodium Load*—patients with coronary or primary myocardial disease and atrial fibrillations showed normalization of sodium after restitution of normal sinus rhythm irrespective of the heart rate; and electrically induced artrial fibrillation and defibrillation in open-chested dogs gave evidence of sodium excretion alterations in atrial rhythm; (3) *Determinants of the Circulatory Response to Upright Tilt*—patients with heart failure tended to maintain blood pressure in response to upright tilt. G.G.

N67-18186# Library of Congress, Washington, D. C. Aerospace Technology Div.
AUTONOMIC AND CARDIOVASCULAR DISORDERS DURING CHRONIC EXPOSURE TO SUPER-HIGH FREQUENCY ELECTROMAGNETIC FIELDS Surveys of Foreign Scientific and Technical Literature
Sheila Penners 6 Oct. 1966 9 p refs
(ATD-T-66-124)

A 10-year study was made of 100 persons (73 men and 27 women from 21 to 40 years of age) exposed for long periods of time to the harmful effects of microwaves with radiation intensities up to several mw/cm^2. In 39 subjects the initial effects of exposure took the form of mild asthenia and autonomic vascular shifts. In 61 persons with moderately severe and severe symptoms of irradiation, the angiodystonic syndrome with hypertensive and angiospastic reactions was observed against a background of increasing cerebral asthenia. These subjects showed extremely unstable autonomic and vascular reactions dominated by hyperactivity and unstable pulse and arterial pressure; 16 subjects showed tachycardia (pulse rate 90 beats/min and more) and 19 showed bradycardia (pulse rate up to 60 beats/min) which was, however, unstable. It was found that functional changes in the nervous system decrease with treatment and the cessation of work around sources of radio frequency radiation. C.T.C.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-16899# Mitre Corp., Bedford, Mass.
STUDIES OF DISPLAY SYMBOL LEGIBILITY. PART X: THE RELATIVE LEGIBILITY OF LEROY AND LINCOLN/MITRE ALPHANUMERIC SYMBOLS
Diana J. Showman Aug. 1966 31 p refs
(Contract AF 19(628)-5165)
(MTR-204; ESD-TR-66-115; AD-640170) CFSTI: HC $3.00/MF $0.65

The legibility of standard Leroy alphanumeric symbols was compared with a new font, the Lincoln/MITRE (L/M) font. Legibility was tested by having human subjects attempt to identify the symbols when seen one at a time for a brief exposure period. The results showed the L/M font to be more legible than the standard Leroy. It is recommended that the two fonts be compared in a similar test on a TV monitor; this study is presently being conducted.
Author (TAB)

N67-16937# Colorado Univ., Boulder.
PERSONALITY DIFFERENCES IN DISSONANCE RESOLUTION
O. J. Harvey and Robert Ware Oct. 1966 16 p refs
(Contract Nonr-1147(07))
(TR-18; AD-641511) CFSTI: HC $3.00/MF $0.65

Following the induction of either a positive or negative impression of an object person (OP) through descriptions of his past behavior, concrete and abstract Ss were presented descriptions of OPs present behavior that run counter to their past and wrote a two paragraph explanation of the perceived consistency-inconsistency. Concrete Ss, significantly more than abstract individuals, (1) perceived inconsistencies between OPs past and present behavior, (2) were negatively aroused by the inconsistency, (3) sought to neutralize the inconsistencies by attributing them to temporal change in OPs, (4) gave few explanations of the inconsistencies, (5) gave poorly integrated accounts of the inconsistencies, and (6) used stereotypic labels in their explanations. In addition, concrete Ss were significantly less tentative in their conclusions about the OPs and significantly more likely to view OPs possession of desirable and undesirable characteristics as mutually exclusive.
Author (TAB)

N67-16939# System Development Corp., Santa Monica, Calif.
SELECTIVE CHANGES IN THE PRESENTATION OF RANDOM SHAPES AS A DETERMINANT OF JUDGED COMPLEXITY
Charles P. Allen 1 Jul. 1966 58 p refs
(SP-2566/000/00; AD-640650) CFSTI: HC $3.00/MF $0.65

The paper reports on a study conducted to determine the effects on judged complexity which result from selected changes in the number and range of complexity levels associated with a series of randomly derived stimulus shapes. Human subjects were required to judge the complexity of a series of tachistoscopically presented stimulus shapes, where judgements followed the presentation of a sample or anchor stimulus. The results show that judged complexity can be significantly effected by (1) a change in the number of complexity levels presented; (2) the complexity of the initial stimuli presented in a series of stimulus presentations findings indicated an inverse correlation between the constructed complexity of sample stimuli and the judged complexity of subsequent stimuli); and (3) the constructed complexity of the stimulus being judged. Results also indicated that complexity level interaction may function as an identifiable factor which effects complexity judgements. Finally, the results suggest that variables shown to contribute to judgements of complexity constitute an aggregate, where each member of the aggregate must incorporate appropriate weighting factors in order to improve the reliability of predictions concerning complexity judgements.
Author (TAB)

N67-16975# Aerospace Medical Div. Personnel Research Lab. (6570th), Lackland AFB, Tex.
USING THE ELECTRONIC COMPUTER TO DEFINE AND IMPLEMENT POLICY
Raymond E. Christal *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 20 p refs (See N67-16982 07-34) CFSTI: HC $3.00/MF $0.65

Using an electronic computer, the fixed-X regression model can be applied to determine how relevant variables must be weighted in order to reproduce a sample of judgments rendered by an individual or committee. Equations thus far developed are highly valid, and have held up on cross-application. Similarities and difference in policies can be detected by clustering judges in terms of the homogeneity of their regression equations. In a recent study, a Hq USAF board of senior officers reviewed descriptions of 3575 representative officer positions and made decisions concerning the appropriate grade level to be associated with each. In an effort to identify the factors considered by these board members in making their judgments, over a hundred variables were hypothesized and evaluated. A nine-predictor equation was developed which accurately reproduced the board's actions. Other applications of the model are also discussed.
Author

N67-16981# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
MACHINES THAT COMMUNICATE AND DESIGNERS WHO DON'T
J. Albert Southern *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 20 p refs (See N67-16982 07-34) CFSTI: HC $3.00/MF $0.65

The area of system design and human factors engineering consists of the language words or symbols that are frequently made a part of the machines, tools, or components of the system, plus the language elements that make up the charts, blueprints, and manuals prepared for use by the human operators who become a critical link in the functioning of the system is discussed. Examples, illustrations, and data are cited to show that changes in the words used in man–machine systems may produce great improvements in system performance. The viewpoint is presented that this critical area exists because it has been taken for granted for decades and is rarely recognized as an engineering function in system development. Critical points of communications links and links are discussed and practical techniques for resolving many of the problems are presented.
Author

N67-16982# Air Force Eastern Test Range, Patrick AFB, Fla. Directorate for Range Engineering.
BIOASTRONAUTICS LABORATORY RESEARCH TOOL
Wayne L. O'Hern *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 33 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

The Bioastronautics Laboratory Research Tool is a tool for developing techniques to monitor, analyze, and display the medical status of astronauts on orbit to the supporting medical personnel. Biomedical telemetry data is received in near-real time by a CDC 3100 computer system. Basic computer programs have been written to record, process, and analyse the data for specific contents and for trend analysis. Data output can be presented on paper or magnetic tape, printed readout, status boards, or cathode ray tube displays. Development of more sophisticated analytical and display programs will be possible with the Bioastronautics Laboratory Research Tool.
Author

N67-16983# Air Force Eastern Test Range, Patrick AFB, Fla. Gemini Launch Vehicle Div.
THE GEMINI LAUNCH VEHICLE PILOT SAFETY PROGRAM

John A. Schira, Jr. *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 23 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

This report describes in detail the disciplines of the Gemini Launch Vehicle Pilot Safety Program which are applied during checkout and launch of the booster vehicle. These disciplines include: test procedure review and approval, screening of all closed discrepancy reports, recorder and telemetry data review, screening of replacement components via data package approval, and approval authority over contractor corrective action activities. The organization and duties of the 6555th Aerospace Test Wing Pilot Safety personnel are described and recommendations are made for the application of reliability assurance disciplines to the checkout and launch phase of other Air Force programs. Author

N67-16995# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN EVALUATION OF THE ACCELEROCARDIOGRAPH AS AN INSTRUMENT FOR MEASUREMENT OF PHYSIOLOGICAL PARAMETERS

Harold G. Vielhauer *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 31 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

This study concerns the use of an accelerometer as the transducer (Accelerocardiograph) for the measurement of accelerometric precordial vibrations. Experiments were conducted on five dogs to determine the effects of transducer positioning on the configurations of the Accelerocardiogram (ACG); the relationship of common electrical and mechanical events of the heart and correlation studies between blood pressure and amplitude of the ACG. The data revealed that the ACG is an instrument that produces data which can be quantified and is virtually unaffected by position of the transducer on the chest wall. It was also demonstrated that a relationship existed between the ACG and the ECG and that the first wave form (C–H) of the ACG could be used as an index for an indirect measurement of blood pressure. Author

N67-17036# School of Aerospace Medicine, Brooks AFB, Tex.

DESIGN AND DEVELOPMENT OF AN AUTOMATIC INDIRECT BLOOD PRESSURE MONITORING DEVICE, FEBRUARY–DECEMBER 1964

James E. Allred and Jack B. Johnson Sep. 1966 14 p ref (SAM-TR-66-80; AD-641017) CFSTI: HC $3.00/MF $0.65

The design of an automatic electronic blood pressure recording device is described. This device, which applied pressure only slightly higher than the systolic pressure of the subject, is programed to record the Korotkoff sounds while the occlusion cuff is being inflated. The system may be programed to monitor blood pressure at any predetermined rate from intervals of one minute to several minutes, or it may be initiated manually. Proper design of circuitry for maximum signal-to-noise ratio required a knowledge of the frequency range of the complex Korotkoff sound waveform. This information was obtained by recording the K sounds from four subjects and analyzing the waveforms for energy content vs. frequency. These data are also presented. Author (TAB)

N67-17235# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SELECTION OF A RATIONAL DIAGRAM FOR A COOLING SYSTEM IN SPACE

O. N. Favorskiy 27 Jun. 1966 18 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), no. 1, 1966 p 143–150

(FTD-MT-66-30; TT-66-62498; AD-640727) CFSTI: HC $3.00/MF $0.65

Expressions are given for determination of basic parameters that characterize space cooling systems: specific area of radiator and specific power. Optimum parameters of diagrams are shown and a comparison is given of diagrams for optimum parameters using specific examples. Author (TAB)

N67-17248# Army Natick Labs., Mass. Pioneering Research Div.

HUMAN FACTORS REQUIREMENTS FOR THE DESIGN OF HELICOPTER AIRCREWMEN'S SEAT AND GROIN PROTECTIVE UNITS

Richard L. Burse Sep. 1966 15 p refs

(EPR-11; TR-67-28-PR; AD-640891) CFSTI: HC $3.00/MF $0.65

The most important human factors requirements for the design of rigidly armored seat and groin protective units for the seated helicopter aircrewmen are discussed. Included are requirements for preventing interference with mission performance, reducing fatigue and providing a compatible, safe and somewhat comfortable working environment for the fully-equipped aircrewman. Quantitative design criteria for dimensions, contours, cushioning and location of the seat and groin protective units are specified. Author (TAB)

N67-17255*# School of Aerospace Medicine, Brooks AFB, Tex.

A SIMPLE PORTABLE SOMOMICROMETER, MARCH–JULY 1966

Merrill B. Kardon, Hugh F. Stegall, and Hubert L. Stone Nov. 1966 17 p refs

(Grant T-37761-G)

(NASA-CR-81559; SAM-TR-66-96; AD-641571) CFSTI: HC $3.00/MF $0.65 CSCL 06L

The design and construction of a relatively simple and inexpensive ultrasonic dimension gage (sonomicrometer) are described in detail. Two piezoelectric crystals are installed surgically across the organ to be studied, and the transit time for a burst of ultrasound to pass from one crystal to the other is measured. The device is easily calibrated when sound velocity in the medium is known. By use of integrated circuits throughout, it may be duplicated for less than $55. Possible applications other than continuous measurements of organ size are discussed. Author (TAB)

N67-17271 Chicago Univ., Ill. Inst. for Computer Research.

THE PRODUCTION AND STABILIZATION OF REAL-TIME TASK SCHEDULES

G. K. Manacher *In its* ICR Quart. Rept., No. 9, 1 May 1966 31 p refs (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

A model for multiprocessor control is considered in which jobs are broken into various pieces called tasks. Tasks are executed by single processing units. The structure controlling the assignment of tasks to processors is the task list, which orders all tasks according to servicing priority. When a processor becomes free, it simply picks up the highest priority task that is executable at that moment. The job and its component tasks are imagined to be interacting with an environment consisting of a set of rigid timing constraints. Such constraints are of two types, called start-times and deadlines. The interaction is specified by requiring that certain distinguished tasks conform directly to one or more of these constraints. Tasks conforming to a start-time cannot begin until the start-time has passed, and tasks conforming to a deadline cannot proceed beyond the deadline. In the model all tasks have known maximum run-times, but in any particular job execution, task run-times are unknown. Author

N67-17292* AiResearch Mfg. Co., Los Angeles, Calif.

GEMINI EXTRAVEHICULAR SUIT PRESSURIZATION VENTILATION TEST SERIES

W. G. Nelson, ed. 19 Jun. 1964 120 p refs Revised

(Contract NAS9-2412)

(NASA-CR-65559; SS-3135, Rev. 1) CSCL 06M

Tests carried out to determine the oxygen flow requirements for CO_2 washout, ventilating flow requirements for cooling, and pressure drop characteristics of the Gemini extravehicular suit are described. Details are given on the test facility, subject evaluation and test procedure, data reduction and error analysis, the test results, and the effect of these results on the extravehicular life support system. The following conclusions were reached: (1) Achievement of a heat balance as moderate gas flow rates is possible below total heat loads of approximately 1230 Btu/hr. (2) The design metabolic and external heat loads of 1650 and 2250 Btu/hr can be accommodated at the design suit flows only by storage of heat in the astronaut. (3) The estimated maximum heat removal capability at the design suit flows of 15.0 and 18.7 cfm is 1168 and 1271 Btu/hr. (4) Carbon dioxide washout is sufficient for anticipated vent gas flow rates and metabolic rates. (5) The suit pressure drop characteristics are valid as previously specified. Recommendations are also included. L.E.W.

N67-17427# Oak Ridge National Lab., Tenn.

THE PRESENT STATUS OF NEUTRON MONITORING FOR PERSONNEL PROTECTION

J. A. Auxier [1966] 27 p refs Presented at the Symp. on Neutron Monitoring for Radiol. Protect., Vienna

(Contract W-7405-ENG-26)

(ORNL-P-2467; SM-76-67; CONF-660807-4) CFSTI: HC $3.00/MF $0.65

Developments in neutron dosimetry during the past twenty years are reviewed including: scintillation systems; cylindrical or spherical moderators with thermal neutron detectors located on the axes or at the centers; proportional counters; solid-state detectors; thermoluminescent and photoluminescent systems; liquid ionization chambers; and the use of heavy ion tracks in insulating solids. It is speculated that the most significant change in the field of radiological monitoring will be the substitution of solid-state devices for the film and nuclear emulsions in personal dosimeters, and it is forseen that solid-state detectors and operational analyzers will be used for measurements of absorbed dose, LET, and other parameters. NSA

N67-17546# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

ANTICONTAMINATION CLOTHING: NO BUTTONS, ZIPPERS, OR TAPING REQUIRED

J. T. FitzGibbon Jun. 1966 9 p Presented at the 11th Ann. Meeting of the Health Phys. Soc., Houston, 27–30 Jun. 1966

(Contract W-31-109-ENG-52)

(CONF-660621-1) CFSTI: HC $3.00/MF $0.65

Anticontamination protective clothing was developed for use by personnel performing maintenance on nuclear reactor plants. The clothing is designed to protect the worker's head, neck, and ears, body, and extremities from radioactive contamination; eliminate clothing closure devices such as buttons, snaps, and zippers which could become separated from the garment and fall irretrievably into open reactor plant systems and components; and eliminate the profuse use of pressure sensitive tapes customarily applied to the garment to seal flyfronts, pockets, and other openings, and secure gloves and shoe covers to the garment. Author (NSA)

N67-17551# Princeton-Pennsylvania Accelerator, Princeton, N. J.

USE OF THE MULTISPHERE NEUTRON DETECTOR FOR DOSIMETRY OF MIXED RADIATION FIELDS

Miguel Awschalom 5 Aug. 1966 47 p refs Presented at the Symp. on Neutron Monitoring Radiological Protect., Vienna, 29 Aug.–2 Sep. 1966

(Contract AT(30-1)-2137)

(PPAD-596-E; CONF-660807-6) CFSTI: HC $3.00/MF $0.65

The energy response of the spherical neutron detectors with 6LiI crystals has been described by Bonner and Hankins. These detectors have been used at the PPA in complete sets together with a muscle tissue equivalent chamber in an attempt to improve the accuracy of mixed radiation dosimetry. The multisphere method is used in conjunction with a computer to estimate the neutron field parameters. Two of these parameters are the dose and dose equivalent delivered by the neutrons. Although the method of spectrum unfolding is discussed and the results of unfolding monochromatic and some continuous spectra are presented, the energy spectrum is used only to calculate total dose and total dose equivalent, using data published by various authors. The results are evaluated from the point of view of dose estimates. All estimates of dose equivalent per detector count are shown for 20, 25, and 30 cm spheres. Finally, a word about the relative merits of iron and lead as shielding materials for high energy neutron shielding and collimation, is given in the light of neutron spectra obtained bombarding Al, Fe, Pb and depleted U-238 with BeV neutrons. Author (NSA)

N67-17601*# Naval Air Engineering Center, Philadelphia, Pa.

A REPORT OF THE PHYSIOLOGICAL, PSYCHOLOGICAL, AND BACTERIOLOGICAL ASPECTS OF 20 DAYS IN FULL PRESSURE SUITS, 20 DAYS AT 27,000 FEET ON 100% OXYGEN, AND 34 DAYS OF CONFINEMENT, PARTS I, II, III

Kenneth R. Coburn Washington, NASA, Feb. 1967 272 p refs

(Grant T-25750-G; Contract NAS9-4172)

(NASA-CR-708; NAEC-ACEL-535, Pt. I; NAEC-ACEL-535, Pt. II; NAEC-ACEL-535, Pt. III) CFSTI: HC $3.00/MF $0.65 CSCL 06S

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14. FULL PRESSURE SUITS AND PERSONAL HYGIENE G. L. Kellett, T. Turaids, and K. R. Coburn p 251-254 (See N67-17615 07-04)

N67-17652# School of Aerospace Medicine, Brooks AFB, Tex.

A SECOND STUDY OF FACTORS AFFECTING AIRCREW MORALE, JANUARY-JUNE 1966

Bryce O. Hartman, George K. Cantrell, and Lewis S. Sims, Jr. Nov. 1966 19 p ref

(SAM-TR-66-91; AD-643820) CFSTI: HC $3.00/MF $0.65

A questionnaire concerning aircrew morale and job-satisfaction was completed by 283 officers and 138 enlisted aircrewmen in three Military Airlift Command Navy squadrons. The stability and predictability of off-duty time, with emphasis on scheduled time off-duty and elimination of wasted time on-duty, were an area of major concern to the Navy aircrewmen. Officers and enlisted men expressed essentially the same attitudes. Responses were generally more moderate than in an earlier study with Air Force aircrewmen. Satisfactions derived from flying apparently attenuated negative feelings to a considerable extent. TAB

N67-17658# Philco Corp., Willow Grove, Pa.

A STUDY AND INVESTIGATION OF THE QUANTIFICATION OF PERSONNEL IN MAINTENANCE Interim Report, Mar.-Jul. 1966

B. E. Crumrine, T. H. Levine, C. F. Martinetz, A. Shultz, and U. Shvern Griffiss AFB, N. Y., RADC, Oct. 1966 156 p refs

(Contract AF 30(602)4125)

(RADC-TR-66-442; AD-643544) CFSTI: HC $3.00/MF $0.65

A study design is presented for application to airmen technicians performing electronic maintenance to determine those variables which may serve as indicators of technician proficiency. A literature review was conducted and variables indicating some promise of predictive value of quality of electronic maintenance performance were selected for further refinement. A method for the quantification of human maintenance performance in electronic systems is provided. A mathematical plan for the development of a human performance figure of merit and determination of degree, and significance of relationship between the variables and the figure of merit is included. Author (TAB)

N67-17750# Naval Training Device Center, Port Washington, N. Y.

USE OF THE OPERATIONAL FLIGHT TRAINER

Alexander Goldman, Harold A. Voss, Gerald J. Fox, and Clifford P. Seitz [1966] 73 p ref

(NAVTRADEVCEN-1734-00-1; AD-643498) CFSTI: HC $3.00/MF $0.65

In order to improve design from an instructional standpoint, an analysis was made of instructor activity in operational flight trainers. A steering committee consisting of engineers, training specialists, maintenance and requirements personnel recommended that the study concentrate on the F9F-5 and P2V-5 operational flight trainers as typical. These trainers were studied both in the training command and in fleet training in terms of current utilization and in terms of a maximum utilization program. This latter was defined as a training regime composed of a set of problems using the full training potential of the device. This was seen as having important design implications if using the trainer at its full potential saturates the instructor. TAB

N67-17860# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

A QUANTITATIVE IMPEDANCE PNEUMOGRAPH

George E. Bergey, William C. Sipple, William A. Hamilton, and Russell D. Squires 10 Nov. 1966 33 p refs

(NADC-MR-6622; AD-643687) CFSTI: HC $3.00/MF $0.65

The report describes an impedance pneumograph capable of measuring quantitatively respiratory volumes. Features of this system include the use of a higher frequency (300 KhZ) excitation voltage than is normally used in impedance pneumography and the use of pasteless electrodes which are insulated from the subject by a layer of polyethylene, thus forming a capacitive coupling of the electrodes to the subject and eliminating the problems associated with skin-to-electrode impedance changes. a near perfect empiric correlation was found to exist between the transthoracic impedance measured by this device and pulmonary volume. Author (TAB)

N67-17913# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

F-4C FLIGHT SIMULATOR FLASHBLINDNESS EXPERIMENT

James E. Hamilton Aug. 1966 17 p refs

(SAM-TR-66-72; AD-642749) CFSTI: HC $3.00/MF $0.65

A study was made to determine visual recovery time from flashblindness in the F-4C aircraft simulator. When 1,080 lux (100 ft.-c.) panel illumination was used immediately after the pilot was exposed to a flash of light in the forward cockpit, visual recovery time was significantly reduced. Visual recovery time was significantly less in the F-4C simulator than that found by previous studies in the F-106 and the C-131 simulators, even though the same light source and recovery task were used. The effect of flashblindness on aircraft control in the F-4C was similar to that found in the F-106 and the C-131 studies. Even though recovery time is significantly shorter than that found in the F-106 simulator under the conditions of this test, there is evidence that flashblindness may still be a problem because of its effect on aircraft control in the F-4C aircraft simulator. Author (TAB)

N67-17914# Air Force Systems Command, Wright-Patterson AFB, Ohio.

AN EVALUATION OF MAN'S CAPABILITY TO PERFORM SUPPORT FUNCTIONS IN SPACE

Chester B. May and A. E. Holmes (Martin Co., Baltimore) Oct. 1966 13 p refs Presented at the 17th Intern. Astronautical Congr., Madrid, 10-15 Oct. 1966 Prepared Jointly with Martin Co.

(AFAPL-CONF-67-4; AD-641287) CFSTI: HC $3.00/MF $0.65

As future space missions extend man's stay time in space past thirty days, support activities such as maintenance, assembly and resupply will become necessary. Development of this support technology must be integrated with development of advanced spacecraft systems. Analytical techniques and data on human performance limitations and support equipment capabilities are being developed so that support posture for a given mission can be optimized with the system development. Although programs have been conducted since 1960 in the investigation of specific areas such as special tools or accessory equipment, including orbital experiments for evaluation, much more development is needed before a true in-space support capability can be said to exist. Author (TAB)

N67-17929# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Inst.

EVALUATION OF THE PHYSIOLOGICAL PROTECTIVE EFFICIENCY OF A NEW PROTOTYPE DISPOSABLE PASSENGER OXYGEN MASK

Ernest B. McFadden Apr. 1966 27 p refs

(AM-66-7) CFSTI: HC $3.00/MF $0.65

A prototype of a new design disposable passenger mask applicable for emergency use in jet transports at altitudes to 40,000 feet was evaluated. Six subjects instrumented to obtain a variety of physiological information were exposed to a chamber flight profile designed around the National Aerospace Standard 1179. The two alternative methods of determining mask performance suggested in this document and based on gas analysis and blood

oxygen saturation were used simultaneously in this study. In order to stimulate the respiration to the 30-liters/minute volume levels specified in applicable regulations, the subject exercised on a bicycle ergometer through the chamber flight up to and including 40,000 feet. Airbreathing baselines were established at 10,000 and 14,000 feet with the subject resting. The 14,000-foot baseline determination was repeated at 14,000 feet exercising at the same work load level as used in the high-altitude tests. The mask maintained all subjects in a satisfactory physiological condition at all altitudes up to and including 40,000 feet for the duration of exposure used in these tests. Author

N67-17931# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

EVALUATION OF THE SIERRA, HANGING, QUICK-DON, CREW, PRESSURE-BREATHING, OXYGEN MASK

Ernest B. McFadden and Michael T. Lategola Jun. 1966 32 p refs

(AM-66-20) CFSTI: HC$3.00/MF$0.65

A new design, hanging, quick-don crew pressure breathing oxygen mask applicable to jet-transport operations was tested and evaluated in three phases, consisting of (1) exposing five masked subjects to a stepwise altitude-chamber flight profile with a maximum altitude of 43,000 feet; (2) rapidly decompressing five masked subjects from 8,000 to 40,000 feet in 45 to 50 seconds; and (3) similarly decompressing these subjects and donning the mask during the decompression. Donning was accomplished in 2.5 to 6.3 seconds after the donning signal, at altitudes varying between 28,000 to 31,000 feet. When used with a pressure-breathing regulator incorporating the military pressure-breathing schedule, the mask maintained subjects in a satisfactory physiological condition at 43,000 feet. When worn prior to and during a rapid decompression, the mask provided adequate protection. When donned during the rapid-decompression profile, there was a significant transient decrease in blood saturation without loss of consciousness followed by a rapid recovery of blood saturation. Author

N67-17932# Federal Aviation Agency, Washington, D. C. Aeromedical Applications Div.

RECENT FINDINGS ON THE IMPAIRMENT OF AIRMANSHIP BY ALCOHOL

Stanley R. Mohler Sep. 1966 12 p refs

(AM-66-29) CFSTI: HC$3.00/MF$0.65

A significant number of fatal general aviation accidents have definitely been associated with the effects of consumed alcohol. These effects can markedly impair the judgment and proficiency of airmen. Aspects of this subject are explored in depth. Author

N67-17933# Federal Aviation Agency, Washington, D. C. Aeromedical Applications Div.

OXYGEN IN GENERAL AVIATION

Stanley R. Mohler Sep. 1966 8 p

(AM-66-28) CFSTI: HC$3.00/MF$0.65

General aviation pilots are increasingly ascending to altitudes exceeding ten thousand feet. As one becomes exposed to heights above twelve thousand feet, blood oxygen saturation diminishes in accordance with a predictable schedule. Recommended measures for the provision of adequate supplemental oxygen are described. Author

N67-17941# Netherlands Research Center TNO for Shipbuilding and Navigation, Delft.

HUMAN REACTION TO SHIPBOARD VIBRATION, A STUDY OF EXISTING LITERATURE [TRILLINGSHINDER AAN BOORD VAN SCHEPEN, EEN LITERATUURSTUDIE]

W. Ten Cate Aug. 1966 23 p refs In DUTCH

(TDCK-46426) CFSTI: HC$3.00/MF$0.65

A literature survey on the effects of shipboard vibrations on humans is reported. Data indicates that human tolerance of vibrations depends on frequency, direction of the vibrations, and other factors. Results of experiments performed by a number of investigators are reviewed and publications on the limits of acceptable vibrations are cited. S.C.W.

N67-18069# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

CORTICAL CONTROL OF EYE MOVEMENTS

P. L. Latour 1966 102 p refs

(TDCK-46512; IZF-1966-12) CFSTI: HC$3.00/MF$0.65

Studies of the absolute threshold and the contrast threshold in vision were conducted to gain knowledge about the performance of the eye under different conditions of illumination. The starting point of work was the apparent contradiction between two phenomena relevant to eye movements. In the first place it has been reported that stabilization of the image on the retina produces a deterioration of vision. Secondly, reports state that the threshold is raised during a 'flick', the rapid eye movement made to compensate for a slow drift of the eye. Rather than using measurements made during involuntary movement, the influence of voluntary movements was studied using a measuring and recording technique. It was found that the visual threshold increases during an eye movement and that this increase anticipates the eye movement. This indicated the existence of a mechanism which triggers the eye movement, meaning, in other words, that the moment of the start of eye movement is under cortical control. S.P.

N67-18072# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

THE EFFECT OF SUCCESSIVE EXPOSURES UPON DYNAMIC VISUAL ACUITY

L. F. W. de Klerk, J. P. van de Geer, and C. A. J. Vlek [1966] 20 p refs

(TDCK-46508; IZF-1966-10) CFSTI: HC$3.00/MF$0.65

This study concerns the effect of manner of presentation of moving Landolt rings upon dynamic visual acuity. Two types of presentation are used: one single exposure and two successive exposures. The total exposure time has been kept equal for both conditions. From the results of the experiments it appears that for an angular target velocity of 70°/sec two successive exposures, separated by a time interval of .2 sec, lead to better performance than one single exposure of double duration. These results were explained in terms of the sampled data theory. Recordings of eye movements do reveal that there is a rather good correlation between dynamic visual acuity and accuracy of ocular pursuit. However, the sampling hypothesis did not receive much support from the analysis of eye movements. Some factors are discussed which may account for this lack of confirmation. Author

N67-18085*# California Univ., San Diego. Visibility Lab.

VISUAL PERFORMANCE ON THE MOON

John H. Taylor Jan. 1967 13 p refs Presented at the 17th Congr. of the Intern. Astronautical Federation, Madrid, 13 Oct. 1966

(Grant NGR-05-009-059)

(NASA-CR-81756; SIO-Ref.-67-3) CFSTI: HC $3.00/MF $0.65 CSCL 05E

This paper discusses the optical and photometric properties of the lunar surface environment and their implications for human visual performance. The need for specialized training of selenonauts is pointed out, and some suggested studies for the Lunar International Laboratory are given. Author

N67-18190# Joint Publications Research Service, Washington, D. C.
OLFACTORY SENSE AND ITS SIMULATION BY MODELING
R. M. Mazitova, V. N. Okhotskaya, and B. I. Puchkin 7 Dec. 1966 14 p refs Transl. into ENGLISH from the book "Obonyaniye i Yego Modelirovaniye" Novosibirsk, Nauka Publishing House, 1965 p 106–114; 119
(JPRS-38994; TT-66-35417) CFSTI: $3.00

Consideration is given to the functional modeling of olfactory processes for their reproduction at the engineering level. It is pointed out that the usefulness of the models discussed is determined not by their absolute correctness or correspondence to the olfactory analyzer, but whether they can offer a more rational approach to the study of olfaction, or help in the elicitation of the true nature of olfaction. Devices are described which make it possible to evaluate the quality and intensity of odors, and also obtain some idea as to the nature of odors. A.G.O.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-16857# Polytechnic Inst. of Brooklyn, N. Y.
SYNTHESIS AND CHARACTERIZATION OF POLYMERIC ABLATION MATERIALS
J. Fock and G. Gordiner *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 243–266 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Studies on the synthesis and characterization of polymeric systems for space vehicle protective coatings are reported. Particular emphasis is placed on ablators which have low irradiation and particle emissivity under conditions established in a typical atmospheric reentry. Crosslinking by ionizing radiation in carbon black filled Teflon was established by mechanical and thermoanalytical methods. A graft-polymer combining the highly thermostable 'black orlon' with Teflon was synthesized and characterized by thermoanalysis. Two mathematical methods were developed to evaluate the decomposition kinetics of polymeric ablators, and it is reported that the synthesis of a siloxane type of ladder-polymer is continuing. C.T.C.

N67-16900# Naval Research Lab., Washington, D. C.
DRY-PACKED BEDS FOR THE REMOVAL OF STRONG-ACID GASES FROM RECYCLED ATMOSPHERES Final Report
S. T. Gadomski 30 Aug. 1966 13 p refs
(NRL-6399; AD-642274) CFSTI: HC $3.00/MF $0.65

Under certain conditions, strong-acid gases can be formed in recycled atmospheres by the combustion of halogenated hydrocarbons. One control measure involves the use of a dry absorbent filter. Li_2CO_3 has already been used as an absorbent in these filters as a result of a screening test of a number of scavenger materials. In this report the absorptive properties of some other potentially useful materials were examined. Baralyme and soda lime were superior to Li_2CO_3 in air at 76F and over 50% R.H., while the silica-alumina catalyst with monoethanolamine (MEA) impregnant and the silica-magnesia catalyst were almost as effective as Li_2CO_3. However, Baralyme, soda lime, various basic materials (MEA, gaseous NH_3, Na_2CO_3, and quinoline) supported on the silica-alumina catalyst, and the silica-magnesia catalyst were all useless at 140F, especially under dry conditions. Li_2CO_3, therefore, still remains as the most effective absorbent throughout the range of probable conditions. Author (TAB)

N67-16998# Washington Univ., Seattle. Dept. of Chemistry.
A NEW METHOD FOR THE PREPARATION OF FLUORODISULFATE SALTS
Darryl D. Des Marteau and George H. Cady 14 Oct. 1966 9 p refs
(Contract Nonr-477(16); ARPA Order 26-60)
(TR-56; AD-641217) CFSTI: HC $3.00/MF $0.65

Potassium and sodium fluorodisulfates were produced by the reaction of peroxydisulfuryl difluoride with the corresponding peroxydisulfates: $M_2S_2O_8 + S_2O_6F_2 = 2MSO_3F + O_2$ (M = Na or K). When M is ammonium, some NH_4SO_3F was obtained together with much $NH_4SO_3F + SO_3$. Author (TAB)

N67-17080# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
MIXING AND SAMPLING ENRICHED U^{235} FLUID IN CYLINDRICAL STORAGE CYLINDERS Progress Report
James E. Harrell 8 Mar. 1966 108 p refs
(Contract W-7405-ENG-26)
(Y-1502) CFSTI: HC $3.00/MF $0.65

The intermixing of fluid contained in cylindrical safe-geometry tankage, as found in nuclear fuel processing plants handling solutions of fissionable material, was investigated. Utilizing an approximation to pulse-type tracer injection methods, experimental data were collected for four and six-inch-diameter single tank loops, two-in-parallel tank loops, and complex-flow-path tank loops mixed by pump recirculation, and for a six-inch-diameter single vertical tank mixed by air sparging. A defined mixing time (mixing period needed to dispose a tracer pulse to near homogeneity with tank-loop contents) was measured for each type system and found to vary linearly with the recirculation rate when plotted on full logarithmic paper. For single tank loops, mixing time for both completely and partially fill conditions ranged between 10 and 625 minutes for recirculation rates between 1 and 100 gpM. The nature of mixing in parallel-tankage loops was considered by varying the ratio of flow through two identical tanks at aggregate flows between 10 and 100 gpM; an optimum flow split ratio where mixing time is minimized was found to exist at about 0.7. Some of the mixing characteristics for series-parallel flow through a single tank loop were studied; mixing time data for several loop systems were analyzed. In addition, the relationship between dispersion intensity which embodies the effective rate of mixing and Reynolds number was studied for several single tank loops. The relationship was found to be linear when plotted on full logarithmic paper and to deviate significantly at low Reynolds numbers from published data for very long pipelines. Preliminary mixing-time data obtained for the air-sparged tank varied between 11 and 31 minutes at air rates between 0.12 and 5.0 scfm. A theory for the recirculation mixing of fluids contained in cylindrical-tankage loops was developed based on the dispersion model and on the tanks-in-series model. Because either an analog or a digital computer solution is required for each theoretical treatment, only the single-tank-loop theory has yet been tested with experimental data. For this type of loop, when using an experimentally measured dispersion intensity and at Reynolds numbers greater than about 10,000, the predicted mixing times were found to agree within ±30%. Author (NSA)

N67-17119 Atome Industriel, Chatillon-sous-Bagneaux (France).
STUDY OF THE APPLICATION OF ACTIVABLE TRACERS [ETUDE SUR L'APPLICATION DES TRACEURS ACTIVABLES]
C. Bondy Brussels, EURATOM, Sep. 1966 133 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-029-64-7 IRAF)
(EUR-3126.f)

Our study on activable tracers contains a collection of bibliographical and theoretical data and a report on experiments based on these data. The list of reference works on uses already

made of activable tracers is, in principle, complete up to 1 May 1965. A table of comparative theoretical and experimental values on the activation of elements that can be used as tracers enables the searcher to pick out, in each practical case, the one or more tracers that may provide the key to his problem. A theoretical review of highly diluted solutions and a number of experiments on the uptake and aging of tracers provide examples of the test to be applied to each of the theoretically suitable tracer substances. A bibliographical and theoretical study shows how a liquid phase can be labelled in the presence of its vapor. Calculation examples contribute a mathematical basis from which to predict and then interpret each experiment on the true scale. A section on methods of utilizing activable tracers concludes the work. Author

N67-17143# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.

DISSOLUTION OF UC SAMPLES

H. Scherff and G. Magni *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 22–27 refs (See N67-17141 07-22) CFSTI: HC$3.00/MF$0.65

Investigations were performed concerning the preparation of UC samples for the different radiochemical determinations starting from big highly radioactive UC specimens as received after mechanical dismantling of the test elements. The main problem is preparing representative small samples starting from a complete cross section of a UC rod. In discussing methods for the dissolution of UC, a brief review is given of the reactions of UC with H_2O, NaOH, HCl, H_2SO_4 and HNO_3. Experimental results are then presented for the UC dissolution. R.N.A.

N67-17144# European Atomic Energy Community, Ispra (Italy). Analytical Chemistry Lab.

THE ISOTOPIC DETERMINATION OF U^{235} AT LOW CONCENTRATION BY OPTICAL SPECTROGRAPHY

Z. Hainski, G. Rossi, and N. Omenetto *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 28–30 ref (See N67-17141 07-22) CFSTI: HC$3.00/MF$0.65

Experiments using optical spectrography to determine uranium isotopic ratios for low contents of U^{235} are discussed. The hollow cathode lamp was used as the excitation source because of its high stability, lack of spectral background, and highly reduced Doppler effect. To increase the luminous energy of the discharge and consequently to record photographically the low U^{235} concentration, lamps working at a high energy rate were studied. Methods for depositing a uranium sample on the cathode were examined. Graphite was selected as the cathodic material due to its high sublimation temperature and excitation potential and because its spectrum is free from lines and background. The uranium layer was obtained by introducing the sample as a refractory oxide dissolved in hydrofluoric acid. The graphite absorbs gases and much of the solution introduced in the cathod causes a lower sputtering efficiency in the glow. To overcome the diffusion of the solution into the graphite, the cathodes were dipped in a paraffin solution in CCl_4 and the excess paraffin was evaporated. R.N.A.

N67-17145# European Atomic Energy Community, Ispra (Italy). Nuclear Chemistry Lab.

MEASUREMENT OF U^{235} CONTENT IN URANIUM BY ACTIVATION TECHNIQUES

M. Bresesti *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 31–35 refs (See N67-17141 07-22) CFSTI: HC $3.00/MF$0.65

Activation techniques have been used in determining the U^{235} of depleted uranium. In these measurements, information is obtained on the accuracy that can be obtained by activation techniques and on the possibility of using these techniques for burnup determinatons. Measurements from two different activation techniques are reported. The data obtained with the different methods agree and it is concluded that the techniques can be used in the burnup determination when an accuracy of about 2% is sufficient. The accuracy required depends on the depletion of U^{235}. If the activation techniques are to be used, the uranium to be irradiated for the U^{235} content determination has to be carefully purified from the fission products and transformed into a chemical compound of known uranium content. In fact, a known amount of uranium has to be irradiated. R.N.A.

N67-17146# European Atomic Energy Community, Ispra (Italy). Analytical Chemistry Lab.

DETERMINATION OF TOTAL URANIUM IN PURIFIED SOLUTIONS FROM THE DISSOLUTION OF IRRADIATED UC

J. Collin and G. Serrini *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 36–38 refs (See N67-17141 07-22) CFSTI: HC$3.00/MF$0.65

The principles and experimental results of methods for the quantitative determination of uranium in purified solutions from the dissolution of irradiated uranium carbide are discussed. These methods include the extraction of uranium with trioctylphosphineoxide and colorimetric determination with dibenzoylmethane, coulometric determination at controlled potential. Also included are analytical techniques for checking the yield of the different steps of the uranium purification from fission products by solvent extraction. These include gravimetry, volumetry, and colorimetry with H_2O_2 for high uranium concentrations, and fluorimetry for trace amounts of uranium. R.N.A.

N67-17147# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.

URANIUM PURIFICATION FROM FISSION PRODUCTS

H. Scherff and G. Magni *In its* Burnup Determinaton of Nucl. Fuels Sep. 1966 p 39–40 (See N67-17141 07-22) CFSTI: HC$3.00/MF$0.65

The TBP–hexane extraction was tested for the separation of uranium from fission products. Three experiments were performed on uranium solutions obtained by dissolving unirradiated UC in nitric acid of different molarities. The amount of uranium separated was between 20 and 100 mg. The yield of the separation was measured by determining the uranium content in the aqueous phase after the extraction. The yield of the separation in the three experiments was about 99.9%. This yield was obtained in the presence of organic compounds formed in the nitric acid dissolution of UC, which appear not to interfere. The decontamination factors, determined by gamma spectrometry measurements on the initial solution of irradiated UC and on the final nitric acid solution are about 5×10^4 for Ce^{144} and Cs^{137} and about 10^3 for Ru^{106} and Zr^{95}–Nb^{95}. R.N.A.

N67-17149# European Atomic Energy Community, Ispra (Italy). Nuclear Chemistry Lab.

CHEMICAL PROCEDURE IN THE DETERMINATION OF THE STABLE FISSION PRODUCT Nd^{148}

M. Bresesti *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 60–61 refs (See N67-17141 07-22) CFSTI: HC $3.00/MF$0.65

A radiochemical procedure is described which can be used for the separation of the neodymium isotopes from other fission products if the determination of the stable fission product Nd^{148} is required. The method consists of elution through cation exchange resin columns operated at room temperature with alpha–hydroxy–isobutyrate solutions at pH increasing from 3.4 to 4.2. An elution curve obtained in the separation of the rare earths produced in the Th^{232} fission is shown. R.N.A.

N67-17176*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STUDY OF ELECTROLYTIC DISSOCIATION OF CO_2–H_2O USING A SOLID OXIDE ELECTROLYTE

J. Weissbart and W. H. Smart Washington, NASA, Feb. 1967 47 p refs
(Contract NAS2-2810)
(NASA-CR-680) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Samples of the system $(ZrO_2)_{0.85-x}(CeO_2)_x(CaO)_{0.15}$ in the range x = 0 to x = 0.45 were prepared from solution and sintered at 1600°C in oxygen. Analysis by X-ray diffraction indicates that a single phase solid solution having the fluorite structure is formed. Pycnometric density measurements on the mixed oxide system containing fully oxidized ceria, i.e. Ce^{+4}, were also made. Structure and phase relationship are considered, and electrical conductivity and disorder equilibrium are discussed. Electrolysis of CO_2–H_2O was carried out in a 15 mole % calcia–zirconia tube cell at temperatures less than 800°C. The beneficial catalytic influence of water vapor was demonstrated by an increase of oxygen current efficiency from 19% (no water) to 100% at 785°C and 50 mA/cm^2, and from 15% (no water) to 76% at 790°C and 100 mA/cm^2. Cells were also constructed by the use of sealed oxide disks. Electrolysis using 0 and 3 mole % ceria disk cells indicate that loss in current efficiency resulting from the component of electronic conductivity in 3 mole % ceria is compensated by the lower voltage required. M.G.J.

N67-17197# Groningen Rijksuniversiteit (Netherlands). Physical Chemistry Lab.
MOLIONIC LATTICES
Gerard T. Pott and Jan Kommandeur 28 Jun. 1966 9 p refs
(Contract AF 61(052)-769)
(AFCRL-66-677; SR-2; AD-642668) CFSTI: HC $3.00/MF $0.65

A theoretical calculation is presented showing the stability of complex salts built up from ions and molecules. Depending on such parameters as ionization potential, electron affinity, polarizability and lattice parameter conditions can be defined under which such a molionic lattice is stable. Author (TAB)

N67-17231# Explosives Research and Development Establishment, Waltham Abbey (England).
THERMODYNAMICS OF THE CHLORINE–HYDROGEN–SILICON SYSTEM
M. J. Harper and T. J. Lewis 13 Jun. 1966 31 p refs
(ERDE-6/M/66; AD-641310) CFSTI: HC $3.00/MF $0.65

The equilibrium composition of the gas phase and the weight of silicon deposited were calculated for SiCl4/H2 and SiHCl3/H2 mixtures at temperatures ranging from 1000 - 2000K and a pressure of one atmosphere. It is shown that many observations made on the rate of epitaxial silicon deposition from SiCl4/H2 and $SiHCl_3$/H2 mixtures may be explained in terms of thermodynamics alone. Author (TAB)

N67-17258# Little (Arthur D.), Inc., Cambridge, Mass.
ELECTROSTRICTION AND THE DEHYDRATION OF IONS UNDER PRESSURE
R. A. Horne 30 Nov. 1966 12 p refs
(Contract Nonr-4424(00))
(TR-26; AD-642528) CFSTI: HC $3.00/MF $0.65

The postulation of a dense inner zone of electrostricted water surrounding cations in aqueous solution and an outer zone consisting of a rarified Frankwen cluster can account for both electrostriction and the dehydration of ions by hydrostatic pressure-phenomena which hitherto appeared to be mutually incompatible. Author (TAB)

N67-17341 Central Lab. for Radiological Protection, Warsaw (Poland).
IONIZING RADIATION MEASUREMENTS BY USING WIDE-RANGE POLISH MONITORING FILMS [ZWIEKSZENIE ZAKRESU POMIAROWEGO DAWAK PROMIENIOWANIA PRODUKCJI KRAJOWEJ]
T. Musialowicz, J. Wysopolski, T. Jasinska, and Z. Michalski (Polish Photochem. Factory "Foton") 1966 27 p refs In POLISH; ENGLISH summary Prepared Jointly with Polish Photochem. Factory "Foton"
(CLOR/FOTON-53) CFSTI: HC $3.00

The results of investigations of new wide range dosimetric films are described. The films are double emulsion with two different sensitivity emulsions on the same base. The measurement range of the films for gamma rays of Co^{60} is between 60 mR and 1300 R. Fog densities ranged up to 0.18 ± 0.04. Author

N67-17357# European Atomic Energy Community, Petten (Netherlands). Materials Dept.
ISOTHERMAL IONIC MIGRATION IN MELTS
S. Forcheri and A. Berlin Brussels, EURATOM, Oct. 1966 29 p refs
(EUR-3160.E) CFSTI: HC $3.00/MF $0.65

The application of the thin layer electrophoresis and diffusion on ceramic oxides (Al_2O_3, MgO or ZrO_2) using radioisotopes to the determination of isothermal transport quantities in molten salts is described. This technique utilizes two different types of support layer for the electrolyte: powder deposited on fritted impermeable ceramic strips (Al_2O_3 or ZrO_2) or fritted porous ceramic material fixed on similar impermeable strips. The ionic mobilities and transport numbers are calculated by determining the displacement of the labelled zone and the weight of the salt system on the strip, and coulometrically the quantity of electricity. The self-diffusion coefficients are measured from the widening of the labelled zone and from the conductivity of the molten salt system on the strip. The measurement of the ionic mobilities and transport numbers requires also the knowledge of specific conductivities and densities of the electrolyte. Some applications of this method to the investigation of molten nitrates are presented. Author

N67-17376# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
SOME CONSIDERATIONS ON THE NATURE OF THE HYDROGEN BOND AND ON THE STRUCTURE OF WATER [ALCUNE CONSIDERAZIONI SULLA NATURA DEL LEGAME A IDROGE NO E SULLA STRUTTURA DELL'ACQUA]
M. Ageno 24 Jun. 1966 20 p refs In ITALIAN; ENGLISH summary
(ISS-66/24) CFSTI: HC $3.00/MF $0.65

A very common type of molecular associations is examined, in which several molecules, each one stable on its own account, become bound to each other through hydrogen bridges forming a ring. Making use of the Schrödinger equation for the system, the existence of a bound state can be demonstrated. The working hypothesis is made that this new type of collective bond, composed of a ring of hydrogen bridges correlated among themselves, can be identified with the so-called "hydrogen bond", concerning which no satisfactory theory exists to date. On the basis of this hypothesis the structure of water is discussed, specifying the types of molecular aggregates present in it. It is shown how from such a model it follows as a consequence that a molecule of water cannot participate in more than two independent hydrogen bonds, instead of four as maintained till now. This offers the possibility of experimental verification. Author

N67-17428# Tennessee Univ., Knoxville. Dept. of Chemistry.
RECENT STUDIES OF RADIATION-INDUCED CATIONIC POLYMERIZATION
Ffrancon Williams [1966] 20 p refs Presented at the 7th Japan. Conf. on Radioisotopes, Tokyo, May 1966 /ts Paper C/RC-4
(Contract AT(40-1)-2968)
(ORO-2968-21; CONF-660503-4) CFSTI: HC $3.00/MF $0.65

Developments in radioinduced cationic polymerization with particular emphasis on the kinetic aspects, are discussed. Conditions

favoring the occurrence of ionic reactions and the criteria by which such polymerization processes can be recognized in bulk monomer systems are considered, along with general kinetics and the contribution of these studies to the general theory of ionic polymerization. NSA

N67-17429# Illinois Univ., Urbana. Dept. of Chemistry and Chemical Engineering.
REACTION OF MONOENERGETIC DEUTERIUM ATOMS WITH HYDROGEN MOLECULES
John Michael White (Ph.D. Thesis) 1966 327 p refs
(Contract AT(04-3)-532)
(CALT-532-2) CFSTI: HC $3.00/MF $0.65

The photolysis of DI–H_2 mixtures was studied using monochromatic light of variable wavelength that furnishes deuterium atoms whose initial velocities are known. The variation of the (D_2/HD) product ratio with (DI/H_2) reactant ratio was studied at 2537, 3030, 3340, and 3660 Å. These wavelengths furnish deuterium atoms with initial relative velocities in the range 1.32 × 10^6 to 0.54 × 10^6 cm sec^{-1} (or relative energies in the range 0.90 to 0.15 eV). Also, the photolysis of DBr–H_2 mixtures was studied at 2537 Å, which furnishes deuterium atoms having an initial velocity of 1.05 × 10^6 cm^{-1} (or energy of 0.57 eV). By comparing the limiting values of (D_2/HD) for a large excess of hydrogen with those obtained in a large excess of helium, the variation of (k_3/k_4) was determined for the reactions $D^* + H_2 \rightarrow DH + H$ and $D^* + H_2 \rightarrow D + H_2$. The observed results show that (k_3/k_4) has a threshold velocity of (0.80 ± 0.02) × 10^6 cm sec^{-1} which corresponds to a threshold energy of 0.33 ± 0.016 eV or 7.7 ± 0.38 kcal $mole^{-1}$. The results obtained using DBr as the source of the hot hydrogen atoms were consistent with those obtained using DI as the hot atom source. NSA

N67-17460# Kentucky Univ., Lexington. Dept. of Chemistry.
DETERMINATION OF ANTIMONY IN NATURAL MATERIALS BY NEUTRON ACTIVATION
James Thomas Tanner (Ph.D. Thesis) 1 Sep. 1966 141 p refs
(Contract AT(40-1)-2670)
(ORO-2670-15) CFSTI: HC $3.00/MF $0.65

The abundance of antimony in 23 chondrites, 8 achondrites, 3 siderites, 5 separated meteoritic phases, 12 tektites, 6 natural glasses, 11 standard rocks, 11 selected terrestrial rocks, and 8 deep-sea sediments was determined by neutron activation analysis. The method used is described. The data confirm the expectation that antimony has appreciable siderophilic and chalcophillic properties in meteoritic matter. The antimony abundances on a weight basis among the ordinary chondrites (average of 0.089 ppM) were found to be very uniform with the maximum variation from the mean for 13 analyses being only approximately a factor of two and the mean deviation less than 20%. The cosmic atomic abundance of antimony was calculated and compared with various reference models. The cosmic atomic abundance for antimony relative to Si = 10^6 was found to be 0.11 based on the ordinary chondrites, 0.40 based on the Type I carbonaceous chondrites, and 0.20 based on the Type III carbonaceous chondrites. The standard and terrestrial rocks were divided into groups ranging from the most acid to the most basic and the average antimony abundances for each group determined. These antimony abundances compare favorably with recent determinations in the literature. In addition deep-sea sediments from a mid-Pacific core and an Argentine Basin core were analyzed for antimony. Values ranged from 0.36 to 7.03 ppM. The data suggest an increase of antimony concentration with depth for the mid-Pacific core but only a random distribution for the Argentine Basin core. Tektites, natural glasses (Libyan Desert and Darwin glass), and impact glass were also analyzed for antimony. Antimony was found to be enriched in going from west to east in the Australian tektites. NSA

N67-17462# Oak Ridge Operations Office, Tenn.
URANIUM HEXAFLUORIDE HANDLING PROCEDURES AND CONTAINER CRITERIA
E. L. Keller, ed. 1966 80 p
(Contracts AT(33-2)-1; W-7405-ENG-26)
(ORO-651) CFSTI: HC $3.00/MF $0.65

Routine handling procedures, container design, and utilization criteria for UF_6 in the AEC are discussed. Criteria for UF_6 weighing, sampling, cylinder filling and emptying, cilnder inspection, cleaning, testing and repairing are described. A brief discussion of the physical and chemical properties of UF_6 and safety considerations for its handling are included. NSA

N67-17465# Mallinckrodt Chemical Works, Weldon Spring, Mo.
ALKALINE-PEROXIDE COLORIMETRIC METHODS FOR THE DETERMINATION OF URANIUM
H. F. Waldron 1 Aug. 1966 63 p refs
(Contract W-14-108-ENG-8)
(MCW-1499) CFSTI: HC $3.00/MF $0.65

A comprehensive review of the literature on the determination of uranium by measuring the absorbance of the uranium peroxide species in an alkaline medium is presented. The factors affecting the accuracy and precision of the measurement are discussed according to whether sodium carbonate, sodium carbonate and sodium hydroxide, sodium hydroxide, or other reagents are used to supply the alkaline medium. The sodium hydroxide system is concluded to be the best for general applications. In all but some special situations, 400 mμ is the optimum wavelength for measuring the uranium peroxide color. Increased sensitivity can be obtained at shorter wavelengths, but the loss of accuracy and/or the necessity for close pH and reagent concentration control nullifies the advantage. Longer wavelengths yield reduced sensitivity with no compensation. The sodium hydroxide system is the most rugged and permits complete standardization of reagent volumes without previous measurements and/or adjustments. The high pH provides better spectral absorbance characteristics and higher tolerance levels of molybdenum, thorium, vanadium, and zirconium than the other systems. The sodium carbonate system requires more operator care, but it is less sensitive to the presence of arsenic, barium, cerium, cobalt, iron, magnesium, manganese, nickel, silicon, tin, and titanium. The higher permissible levels for the elements that precipitate in an alkaline medium are due to less uranium occlusion in the presence of carbonate. To a large extent, this advantage may be obtained in the sodium hydroxide system if the peroxide is added before the solution is made alkaline. When the system contains both sodium hydroxide and sodium carbonate, the spectral absorbance characteristics approach those of the sodium hydroxide system while the interferences become similar to those of the sodium carbonate system. In comparison to the sodium hydroxide system, however, considerably more caution is required to obtain reliable results. A comparison of interferences in the three major systems is shown. Author (NSA)

N67-17474# Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
A DIRECT SPECTROMETRIC DETERMINATION OF Dy, Eu, Gd, AND Sm IN HIGH-PURITY THORIUM DIOXIDE
J. R. Nelms and R. S. Vogel 1 Aug. 1966 11 p refs
(Contract W-14-108-ENG-8)
(MCW-1495) CFSTI: HC $3.00/MF $0.65

An emission spectrometric method was developed for the direct determination of Dy, Eu, Gd, and Sm in the ppM range in high-purity thorium dioxide. The procedure, based on a carrier-distillation technique, utilizes silver chloride as a carrier with neodymium as an internal standard. Excitation in an atmosphere of 80% argon–20% oxygen prevents formation of cyanogen band-spectra and thereby permits the use of sensitive lines in the regions normally obscured by cyanogen bands. The method fulfills the requirements of precision and sensitivity for specification analysis of reactor-grade thorium dioxide with time savings of approximately

60% compared to conventional methods involving chemical separation. Author (NSA)

N67-17481# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh. Nuclear Chemistry Dept.

HIGH ENERGY CHEMICAL REACTIONS IN THE GASEOUS PHASE

S. Amiel and Y. Paiss 1966 19 p refs Presented at the Hot Atom Chem. Symp., Lafayette, Ind., 1–2 Apr. 1966

(IA-1096; CONF-660431-5)

The possibility of displacement reactions taking place at energies much higher than 10 eV was investigated. The upper energy limit for which a reaction will yield a stable product is determined by the decomposition of the product after formation. A molecule produced at high energy may decompose either due to excess excitation or by collision with neighboring molecules. Internal excitation may be reduced by having high momentum transfer to the displaced atom (i.e., the projectile and the displaced atom are of similar masses) and choosing the rest of the molecule to be of low mass, thus minimizing the stretch of bonds. A molecule formed at high energy but with low internal excitation may still have high translational energy; which may be converted to excitation energy upon collision and thus cause decomposition. However, the molecules can survive collisions if the collisions take place with very light atoms, so that there is a low energy loss per collision. Experimental evidence using the CH_3I+I^* reaction in the presence of rare gases is presented and discussed. Author (NSA)

N67-17488# California Univ., Livermore. Lawrence Radiation Lab.

DETERMINATION OF IMPURITIES IN ELEMENTAL BORON BY X-RAY FLUORESCENCE

Lester P. Rigdon 11 Aug. 1966 9 p refs Presented at 1st Mater. Res. Symp. on Trace Characterization: Chem. and Phys., Gaithersburg, Md., 3–7 Oct. 1966

(Contract W-7405-ENG-48)

(UCRL-14879; CONF-661008-2) CFSTI: HC $3.00/MF $0.65

An X-ray fluorescence technique was developed for the determination of Br, Ca, Cl, Cu, Fe, and Ni in elemental boron. Significant segregation of impurities in elemental boron may occur, even in a sample of a few grams. However, samples prepared with jet-milled boron and a graphite matrix are homogeneous and analyses are reproducible to a few percent relative standard deviation. Standards for the X-ray fluorescence analysis of Br, Ca, Cl, Cu, Fe, and Ni may be prepared by addition of standard solutions to a graphite matrix. X-ray instrumentation parameters and comparative analytical results are presented. Author (NSA)

N67-17492# Utah Univ., Salt Lake City. Dept. of Ceramic Engineering.

RECRYSTALLIZATION AND SINTERING OF OXIDES Technical Progress Report, 1 Sep. 1965–31 Aug. 1966

Ivan B. Cutler, James R. Keski, Ronald O. Petersen, John L. Wilcock, Jr., Martin J. O'Hara et al 31 Aug. 1966 132 p refs

(Contract AT(11-1)-1122)

(COO-1122-3) CFSTI: HC $3.00/MF $0.65

The following studies are reported: (1) effects of MnO_2 on sintering of Al_2O_3, (2) effects of water vapor on initial sintering of CaO, (3) effects of Al on sintering of Al_2O_3, (4) sintering kinetics of composite compacts of Al_2O_3, and (5) interdiffusion studies of transition metal oxides in MgO. Author (NSA)

N67-17518*# National Aeronautics and Space Administration, Washington, D. C.

CHARACTER OF THE INTERACTION OF ZIRCONIUM DIOXIDE WITH TITANIUM, NIOBIUM, AND CHROMIUM CARBIDES [KHARAKTER VZAIMODEYSTVIYA DVUOKISI TSIRKONIYA S KARBIDAMI TITANA, NIOBIYA I KHROMA]

T. Ya. Kosolapova, V. B. Fedorus, Yu. B. Kuz'ma, and Ye. Ye. Kotlyar Jan. 1967 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorganicheskiye Materialy (Moscow), v. 2, no. 8, Aug. 1966 p 1521–1523

(NASA-TT-F-10649) CFSTI: HC $3.00/MF $0.65 CSCL 07B

Studies on the mechanism of interaction of a monoclinic modification of zirconium oxide with transition metal carbides (titanium, niobium, and chromium), with the aim of finding refractory materials with improved properties, are described. Percentual compositions of the starting materials and the interaction products are tabulated. Interaction in the system ZrO_2–TiC starts at 1300°C leading, at 1900–2000°C, to formation of a complex oxycarbide with a lattice constant of 4.43 Å. The system ZrO_2–NbC starts interaction at 1500°C and forms a complex carbide plus a complex oxide at 1900–2000°C. Interaction in the system ZrO_2–Cr_3C_2 with a higher carbon content leads to reduction of ZrO_2 to ZrC and formation of Cr_7C_3. The differences in interaction are attributed to the difference in electronic structure of the carbide-forming metals of groups IV, V, VI. Author

N67-17542# Brookhaven National Lab., Upton, N. Y.

SEPARATION COEFFICIENTS OF 12C and 14C BY EQUILIBRIUM EVAPORATION OF METHANE

O. V. Uvarov, N. M. Sokolov, V. V. Lyapin, and N. M. Zhavoronkov Jun. 1966 10 p refs Transl. into ENGLISH from Zh. Vses. Khim. Obshch. (USSR), v. 7, 1962 p 695–697

(BNL-TR-84) CFSTI: HC $3.00/MF $0.65

Radiometric examination of the results of equilibrium evaporation of CH_4 as a means of separating ^{12}C and ^{14}C isotopes gave the separation coefficient 1.0246. The difference in heats of vaporization of $^{12}CH_4$ and $^{14}CH_4$ is 5.2 cal/mole. Author (NSA)

N67-17563# Oak Ridge National Lab., Tenn.

FORMATION OF URANIUM, ZIRCONIUM, AND THORIUM OXIDE MICROSPHERES BY HYDROLYSIS OF DROPLETS

T. A. Gens 10 Jul. 1966 27 p refs

(Contract W-7405-ENG-26)

(ONRL-TM-1508) CFSTI: HC $3.00/MF $0.65

A new method of preparing metal oxide microspheres was investigated in the laboratory. This method involves spraying nitrate or chloride solutions or sols onto a layer of organic liquid floating on ammonium hydroxide solution. Droplets of sol or solution disperse in the organic layer and fall into the ammonium hydroxide, where they hydrolyze to hydroxide microspheres. The hydroxide microspheres are dried and fired to form oxide microspheres. The most successful preparation involved making gels by bubbling ammonia through aqueous solutions, converting the gels to sols by warming, and adjusting the temperature of the sol so that the viscosity was that needed for forming droplets in the organic liquid. Urania and zirconia microspheres with densities up to 99% of theoretical were formed by this method. Sols prepared from chloride salts behaved the same as those prepared from nitrate salts. However, sols prepared from uranium nitrate solution were not stable and it was necessary to use the chloride salt in making urania microspheres. Author (NSA)

N67-17565# Temple Univ. Research Inst., Philadelphia, Pa.

HIGH TEMPERATURE INORGANIC CHEMISTRY Annual Progress Report, 1 Jul. 1965–31 Jul. 1966

A. V. Grosse and J. A. Cahill 15 Aug. 1966 39 p refs

(Contract AT(30-1)-2082)

(RITU-1966-18; APR-8; NYO-2082-6) CFSTI: HC $3.00/MF $0.65

Results are reported for studies on: electric conductivity of liquid tin to 2200°K, liquid bismuth to 1600°K, and liquid lead to 1800°K; use of heat pipe to measure thermal conductivity of solids and liquids by using it with centrifugally rotating liquid pipes; liquid aluminum oxide window; interaction of tungsten with liquid tin, bismuth, and lead; behavior of liquid tungsten carbide with

the liquid solution of carbon in zirconium carbide; and centrifugal plasma jet apparatus. NSA

N67-17587# National Lead Co. of Ohio, Cincinnati.
[TECHNICAL DIVISION WORK] Summary Technical Report, 1 Apr.–30 Jun. 1966
R. Burgett, ed. Jul. 1966 29 p refs
(Contract AT(30-1)-1158)
(NLCO-980) CFSTI: HC $3.00/MF $0.65

In studies of backscatter and secondary electrons in the microprobe analyzer it was demonstrated that the composition of a binary alloy is linearly related to the electron backscatter yield. Therefore, by measuring sample current along the alloy composition can be determined. An infrared spectral study was made of the complexes formed by various metal nitrates, especially thorium nitrate, with diamylamylphosphonate (DAAP). A test lot of uranium fuel cores 2.430 in. OD, by 1.395 in. ID, by 8 in. long were rolled, drilled, and machined to finished size. Author (NSA)

N67-17641# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry.
SOME STUDIES OF THE IONIZING RADIATION INDUCED ISOTOPE EXCHANGE IN GASEOUS NITROGEN Final Report, 1 Jul. 1961–30 Jun. 1964
R. D. Brown, S. Dondes, and P. Harteck Oct. 1966 168 p refs
(Contract AT(30-3)-321; Grants DA-ARO(D)-31-124-140; DA-ARO(D)-31-124-G105)
(RPI-321-9; AROD-3058-2; AD-642579) CFSTI: HC $3.00/MF $0.65

The gas phase isotopic exchange of 14N2 with 15N2 under ionizing radiation was studied in a number of systems important to the ionizing radiation induced fixation of nitrogen. A limited number of experiments were done at temperatures greater than the ambient temperature of the Brookhaven National Laboratory Graphite Research Reactor. Some experiments were also performed using a 60Co source and some utilizing the fission products of 235U. Author (TAB)

N67-17668# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A RAPID MICROANALYSIS OF NITROGEN IN ORGANIC COMPOUNDS SLEEVE-TUBE COMBUSTION METHOD
C. V. Liu and P. C. Chow 20 Sep. 1966 11 p refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peking), no. 3, 1964 p 58–60
(FTD-TT-65-683; AD-643708) CFSTI: HC $3.00/MF $0.65

The paper describes a technique of using a sleeve-tube combustion in determining nitrogen in organic compounds. The oxidizing agent employed is manganese dioxide. Satisfactory results were obtained on all types of nitrogen-containing organic compounds. The temperature of the fixation furnance was also lower (600-650C) than most rapid methods. This will extend the lifetime of the combustion tube. The method is also very economical, simple and fast. Author (TAB)

N67-17674# Sheffield Univ. (England). Dept. of Chemistry.
KINETICS OF THE TRIPLET STATE Final Scientific Report, 1 Sep. 1966–31 Aug. 1966
G. Porter and J. W. Hilpern 30 Sep. 1966 32 p refs
(Contract AF 61(052)-848)
(AFCRL-66-12(11); AD-642482) CFSTI: HC $3.00/MF $0.65

The transients from benzophenone in isopentane solution were studied over a large range of temperatures confirming McClure and Hanst's identification of triplet benzophenone at low temperatures. The ketyl radical of benzophenone in water solution was observed and a quantum yield of benzophenone decomposition under flash excitation conditions was measured as 0.34. The implications of this result are discussed. The n-pi* triplet spectrum of 4-OH benzophenone and the 'charge-transfer' triplet spectra of 4-NH2 benzophenone and 3-NH2 benzophenone were measured at low temperatures. Author (TAB)

N67-17716# Harvard Univ., Cambridge, Mass. Mallinckrodt Lab.
SYNTHESIS OF SILICON COMPOUNDS
Edward Krahe Jun. 1966 73 p refs
(Contract ARPA SD-88)
(ARPA-26; AD-643933) CFSTI: HC $3.00/MF $0.65

There is only one binary alloy system of silicon which is liquid below the temperature of decomposition of methyl chloride, alcohol, and ether: the gold-silicon system. The possibility of using a liquid eutectic form of silicon as starting material for the direct synthesis of organosilicon compounds was so inviting, because of the constant exposure of fresh surface to the stream of organic reagent, that experiments were undertaken. It was expected that no gold would be consumed or transported, and so the high price of the gold would represent only capital investment, the cost of which might be overbalanced by operational advantages. The experiments reported here show that methylchlorosilanes (intermediates for making silicone polymers) are indeed produced from methyl chloride and gold-silicon alloy, but that the gold enters into the reaction in such a way as to be transported as fine dust. The chemical change was studied intensively, along with reactions of methanol and ethers. The report concludes with some work on organoboran chlorides. Author (TAB)

N67-17726# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
ENGINEERING-SCALE STUDIES OF BORON ISOTOPE SEPARATION
J. R. Merriman, J. H. Pashley, and N. W. Snow 15 Apr. 1966 117 p refs
(Contract W-7405-ENG-26)
(K-1653) CFSTI: HC $3.00/MF $0.65

Several disadvantages of boron isotope separation by the dimethyl ether process, which has been used on a production scale in the United States intermittently since 1945, led to engineering-scale studies of a more attractive alternative process based on a gas–liquid chemical exchange between boron trifluoride and a liquid complex formed between boron trifluoride and anisole. An engineering-scale test unit for the anisole process was operated essentially at total reflux, with reflux supplied by complex formation and dissociation in auxiliaries located, respectively, at the boron-11 and boron-10 ends of the separation column. Additionally, an anisole still was employed for continuous solvent purification. The 6-inch diameter isotopic exchange column was packed to a height of 13.5 feet with 5/8-inch Pall rings. During this program, pressures of 20, 26, and 35 psia, anisole flow rates of 1.17, 1.75, and 2.0 gpm, and temperatures from 63 to 105°F were selected for the nineteen isotope separation tests. Correlations were developed for experimentally determined exchange column stage heights, which were found to range from 22 to 43 inches, depending upon the combination of operating conditions used, and for exchange column pressure drops, which varied between about 0.3 and 1.3 inches of water per foot of packing. One flooding test was performed at 28 psia, and 96°F with the indicated flooding flow on an anisole basis being 2.7 gpm. Both complex formation and dissociation were carried out with very low boron losses. The total anisole degradation rates during the tests appeared to be equivalent to between 3 and 7% of the anisole inventory in the still and decomposer systems per day. The choice of materials of construction appeared satisfactory on the basis of recycle liquid analyses. Stainless steel 304L was the primary construction material; however, stainless steel 316 and nickel packing materials were employed

for the exchange column and for the higher temperature still and decomposer sections, respectively. Successful anisole purification and drying methods, as well as general system operability, were demonstrated. Author (NSA)

N67-17735# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
DETERMINATION OF FREE, COMBINED, AND ABSORBED CARBON IN BERYLLIUM
F. W. Postma, Jr. and G. E. Walden 14 Oct. 1966 18 p refs
(Contract W-7405-ENG-26)
(Y-1556) CFSTI: HC $3.00/MF $0.65

Carbon is contained in beryllium metal in three forms: combined, free, and adsorbed. To determine the amount of carbon contamination in beryllium, analytical methods are needed that can separate the carbon in its three forms and reveal the total amount of the element. Combined carbon can be determined by converting the beryllium carbide to methane and sweeping the gas into a gas chromatograph; free carbon can be filtered from the dissolved beryllium sample, ignited to carbon dioxide, and the gas swept into a conductometric cell containing barium hydroxide; and the adsorbed carbon (as CO_2 on the surface of the metal) can be separated from the beryllium by heating the sample in an inert atmosphere and sweeping the gas into the conductometric cell. Author (NSA)

N67-17736# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
PURIFICATION OF CONCENTRATED LITHIUM CHLORIDE SOLUTION BY THE OXINE PRECIPITATION-CARBON ADSORPTION METHOD
W. C. Dietrich 4 Oct. 1966 15 p refs
(Contract W-7405-ENG-26)
(Y-1553) CFSTI: HC $3.00/MF $0.65

A batch method to purify concentrated lithium chloride solutions was developed. Potassium is precipitated as potassium tetraphenylborate, calcium is adsorbed by alumina, and other foreign cations are removed by oxine precipitation and carbon adsorption. Author (NSA)

N67-17769*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
ORIGIN OF ORGANIC MATTER IN EARLY SOLAR SYSTEM. I: HYDROCARBONS
Martin H. Studier (Argonne Natl. Lab), Ryoichi Hayatsu, and Edward Anders Dec. 1965 22 p refs Submitted for Publication
(Grant NsG-366)
(NASA-CR-69930; EFINS-65-115) CFSTI: HC $3.00/MF $0.65 CSCL 08D

Iron and stony meteorites are effective catalysts for a Fischer-Tropsch type reaction between carbon monoxide and hydrogen. Even in hydrogen-rich mixtures approaching cosmic composition, aliphatic and aromatic hydrocarbons are produced rapidly at temperatures between 25°C and 580°C. When these hydrocarbons are partially equilibrated by sustained reheating, they match the hydrocarbon distribution in carbonaceous chondrites in all important respects. Author

N67-17772*# Mellon Inst., Pittsburgh, Pa.
VISCOUS AND VISCOELASTIC BEHAVIOR OF 1, 3, 5-TRI-α-NAPHTHYL BENZENE
Donald J. Plazek and Joseph H. Magill [1966] 66 p refs
(Grant NsG-147)
(NASA-CR-71115) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The torsional creep and creep recovery behavior of amorphous 1,3,5-tri-α-naphthyl benzene was studied while at metastable equilibrium density, along a specified glassy volume-temperature line, and during isothermal volume contraction below the conventional glass transition temperature; T_g. Dilatometric measurements confirmed the conventional T_g to be 69°C. The capillary viscosity measurements were extended from 185°C to below T_g, covering viscosity values from 10^{-1} to 10^{16} Poises. In a region of time scale the mechanical response was found to be dominated by Andrade creep. The retardation spectrum found was over 9 logarthmic decades wide in contrast to reportedly narrow spectra exhibited by other liquids with similar molecular weights. A steady state compliance, J_e, of 2.6×10^{-10} cm^2/dyne at 64.2°C was measured. Free volume theory was found applicable to all measurements made below 120°C. The occupied volume, v_o, was deduced to be temperature insensitive. Author

N67-17811# Aktiebolaget Atomenergi, Stockholm (Sweden).
NEUTRON-ACTIVATION ANALYSIS OF BIOLOGICAL MATERIAL WITH HIGH RADIATION LEVELS
K. Samsahl Sep. 1966 17 p refs
(AE-247) CFSTI: HC $3.00/MF $0.65

A method has been developed for the chemical separation and subsequent gamma-spectrometric analysis of the alkali metals, the alkaline earths, the rare earths, chromium, hafnium, lanthanum, manganese, phosphorus, scandium and silver in neutron-activated biological material. The separation steps, being fully automatic, are based on a combination of ion exchange and partition chromatography and require 40 min. Author (ESRO)

N67-17891# European Atomic Energy Community, Ispra (Italy).
DETERMINATION OF OXYGEN TRACES IN LEAD [DETERMINAZIONE DI TRACCE DI OSSIGENO NEL PIOMBO]
G. Serrini and W. Leyendecker 1966 14 p refs In ITALIAN
(EUR-3072.1)

The trace determination of oxygen in lead is described. Oxygen after reduction by hydrogen at 700°C is transformed in water-steam, which is quantitatively absorbed and titrated by K. Fischer's reagent. The detection limit is 0.6 ppM oxygen. The coefficient of variation of the method is less than 15% at levels between 1.5 and 32 ppM oxygen. Well-known amounts of PbO are found quantitatively. With this technique, 3-4 determinations a day are possible. Author (NSA)

N67-17892# Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
DETERMINATION OF FRACTION OF TRIBUTYL PHOSPHATE COMPLEXED BY IRANIUM AND DETERMINATION OF TOTAL CONCENTRATION OF TRIBUTYL PHOSPHATE IN REFINERY SOLVENT
H. L. Christopherson 1 Aug. 1966 20 p refs
(Contract W-14-108-ENG-8)
(MCW-1435) CFSTI: HC $3.00/MF $0.65

The equilibrium distribution of uranyl nitrate between water and 26 volume percent TBP (tributyl phosphate) in hexane has been experimentally determined and plotted as fraction of TBP complexed by uranyl nitrate, over the range 0.5 to 1, vs density of the aqueous phase. From a comparison of data on the equilibrium distribitions of uranyl nitrate and nitric acid between water and 30 volume percent TBP in Gulf BT, an estimate and curve was made of the equilibrium distribution of uranyl nitrate between 26 volume percent TBP in hexane and the aqueous phase resulting from shaking 1 volume of stock uranyl nitrate solution with 10 volumes of 26 volume percent TBP in hexane solvent containing various amounts of uranyl nitrate and an amount of nitric acid that is in equilibrium with 1M excess HNO_3 in the aqueous uranyl

nitrate feed solution with which the solvent had been contacted. Equations were derived for calculating the fraction of TBP complexed by uranyl nitrate from this curve and from density measurements on the aqueous phase before and after shaking a plant solvent with 1/10 its volume of a stock uranyl nitrate solution. The assumptions made in these derivations are discussed, and the proportionality constants introduced are evaluated from data in the literature and additional experiments. Equations were also derived for calculating the initial concentration of TBP in the solvent from the above data, and an additional aqueous-phase specific-gravity measurement was taken after shaking the equilibrated solvent with 1/10 its volume of distilled water. An estimate of the order of magnitude of the accuracy of determining the fraction of TBP not complexed by uranyl nitrate is the larger of ±10% relative or 0.001 absolute at the 95% confidence level. The precision of this method is estimated to be about 3 to 5 times better than the accuracy. The accuracy of determining the concentration of TBP is estimated to be roughtly ±2% relative and the precision about ±1% relative at the 95% confidence level. Author (NSA)

N67-17894# European Atomic Energy Community, Ispra (Italy).
DETERMINATION OF OXYGEN CONTENT OF REFRACTORY OXIDES BY THE SULPHUR MONOCHLORIDE METHOD [DETERMINAZIONE DELL'OSSIGENO NEGLI OSSIDI REFRATTARI COL METODO AL MONOCLORURO DI ZOLFO]
G. Gigli 1966 26 p refs In ITALIAN
(EUR-3077.i)

The S_2Cl_2 method has been applied to the determination of oxygen in the refractory oxides: ZrO_2, MgO, Al_2O_3. Utilizing the synthesized reagent freshly prepared and HgS as absorbent of S_2Cl_2 excess vapors, the results obtained have been satisfactory. Reaction temperature has been consistent at 900°C. The total standard deviation for the 3 oxides calculated over 26 determinations is ±0.90 for oxygen content between 25 and 50% and for sampling of 20–35 mg. The obtained sensitivity limit is 70 μg oxygen per hour for a flow of inert gas of 1.4 liters per hour and for temperatures of the reagent in its container, near to its boiling point. This method has been applied with good results for the resolution of analytical problems presented by certain particular SAP types, with high contents of combined N, up to 2% and not readily attacked by gaseous HCl at 400°C: for such SAP types the residue of the attack by gaseous HCl is completely volatilized at 900°C by means of S_2Cl_2 vapors. The method is, therefore, advantageous, because, if not a substitutive one of gaseous HCl method, it is at least a good integrative one of the same method for Al_2O_3 determination in SAP. Author (NSA)

N67-17899# California Univ., Livermore. Lawrence Radiation Lab.
ANALYTICAL SECTION Quarterly Report, 1 Apr.–31 Jul. 1966
J. E. Harrar, comp. 4 Aug. 1966 38 p refs
(Contract W-7405-ENG-48)
(UCID-15014) CFSTI: HC $3.00/MF $0.65

Research is reported on: determination of carbon and sulfur in refractory metals; inert gas fusion; vacuum fusion, determination of oxygen in LiH and LiD; modifications of the coincident field mass spectrometer; automation of the CEC 21-103C mass spectrometer; a field operational differential mass spectrometer; gas chromatography data acquisition; reduction of mass spectrometer data; computer programs for spectrophotofluorimetry; processing of emission spectra data; determination of metallic impurities in Ta, W, Mo, and Re; spectroscopy of the actinides; X-ray fluorescence, spectrophotofluorimetry; determination of alkali metal impurities in Cs and Rb; determination of trace W in Ag; trace fluoride analysis; determination of trace cerium in solutions of biological origin; determination of milligram amounts of tin; differential polarography; controlled-potential coulometers; chemical reactivity; inorganic synthesis; determination of trace impurities in gases; helium densitometer; helium carrier gas purification; and automatic apparatus for determination of He diffusion rates. NSA

N67-17939# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
THE ANALYSIS OF PLUTONIUM SILICIDES AND PLUTONIUM SILICON CARBIDES
G. W. C. Milner, I. G. Jones, and G. Phillips Sep. 1966 22 p refs
(AERE-R-5280) HMSO: 3s

Procedures are described for the chemical analysis of plutonium mono- and disilicides, and of plutonium silicon carbides containing from 3 to 14% silicon and 1 to 5.5% carbon. For the determination of silicon, samples are ignited in air to remove carbon and then they are dissolved by an alkaline sodium peroxide sinter technique. For the determination of plutonium a separate sample is taken and dissolved in HNO_3+HF before evaporation to fumes of sulphuric acid. The determination is completed by controlled-potential coulometry with a coefficient of variation of 0.1%. The carbon content is determined by direct combustion in oxygen at 1150°C for all samples except those containing silicon carbide. For these latter samples a PbO-B_2O_3 flux is necessary in conjunction with a temperature of 1330°C. The coefficient of variation for the carbon determination is about 0.3%. Author

N67-17942# United Kingdom Atomic Energy Authority, Harwell (England).
THE SOLUBILITY OF CALCIUM SULPHATE IN HIGH-TEMPERATURE AND SUPERCRITICAL STEAM
O. I. Martynova, Yu. F. Samoilov, and I. S. Kurtova Apr. 1966 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), v. 3, 1964 p 132–136
(AERE-Trans-1058) HMSO: 1s 9d

An attempt is made to obtain a relationship between the equilibrium concentrations and the stream parameters, by thermodynamic analysis of experimental data published in the literature, on the solubility of calcium sulphate in stream. Emphasized is the importance of the determination of such relationships to the optimization of the feed water schedule of steam generators when a water supply source of the calcium sulphate class is used for preparation of the feed water. Empirical formulae are derived for assessment of the contamination of high temperature and supercritical steam in power plants. Included are results of studies carried out at 400°C and low temperatures, and data for temperatures between 400 and 600°C. S.C.W.

N67-18029*# National Bureau of Standards, Washington, D. C.
ELECTROCHEMICAL DATA, PART V Quarterly Report, Oct. 1–Dec. 31, 1966
Harold J. De Wane and Walter J. Hamer 16 Jan. 1967 8 p refs
(NASA Order R-09-022-029)
(NASA-CR-81694; NBS-9472) CFSTI: HC $3.00/MF $0.65
CSCL 07D

Tabulated data are presented, based on a literature survey of the electrolytic conductance of hydriodic acid. These include (1) the equivalent conductance at rounded concentrations in absolute mhos of hydriodic acid at 25°C; (2) the equivalent conductance at rounded concentrations of hydriodic acid over a wide range of

temperatures; (3) interpolation formulas for use over the concentration ranges of tables 1 and 2; and (4) the statistical details for the fits of the conductivity data at the various temperatures. M.G.J.

N67-18042* Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Materials Engineering.
IMPURITY EFFECTS ON HETEROGENEOUS NUCLEATION FROM THE VAPOR: SELENIUM ON GLASS
Bernhardt E. Kressner and John B. Hudson [1965] 24 p refs
(Grant NsG-663)
(NASA-CR-81708) CFSTI: $3.00 CSCL 07D

It has long been recognized that impurities adsorbed on the substrate can have a marked influence on the kinetics of heterogeneous nucleation. However, the detailed nature of these effects has not been demonstrated heretofore. In the present work, impurity effects have been characterized for the nucleation of selenium vapor onto Pyrex glass. It is shown that the degree of surface contamination not only affects the critical supersaturation required for nucleation, but may cause a nucleated phase of other than equilibrium structure. It is also shown that the degree of material accommodation for selenium on Pyrex is affected by surface contamination. These results are discussed in terms of the changes in substrate and nucleus interfacial energies accompanying impurity adsorption, and in terms of the possible masking of ordering influences exerted by a clean substrate. Author

N67-18087* Miami Univ., Fla. Institute of Molecular Evolution.
ON THE REACTIONS OF CARBONYL COMPOUNDS WITH N-SALICYLIDENEGLYCINATO–AQUO–COPPER. II: SYNTHESES OF β-HYDROXY α-AMINO ACID FROM GLYCINE
Kaoru Harada and Jun-ichi Oh-Hashi [1966] 16 p refs Submitted for Publication *Its* Contrib. No. 078
(Grant NsG-689)
(NASA-CR-81743) CFSTI: $3.00 CSCL 07C

Several forms of N-salicylideneglycinato–aquo–copper (II) were synthesized. These complexes were found to be the same in structure except for combining with water. Carbonyl compounds react rather easily with these complexes to form N-salicyliden β-hydroxy amino acid copper complex under conditions of aqueous solution, at room temperature ($25^\circ \pm 1^\circ$), and at neutral to weakly alkaline pH. Threonine, β-phenylserine, β-hydroxyaspartic acid, and serine were synthesized. The yields dependent on reaction time and the ratios of *threo* and *erythro* isomers were studied. The reactions are similar to those non-enzymatically catalyzed by pryidoxal and the complexes could be regarded as the benzene analogs of pyridoxal-amino acid complexes. Author

N67-18099*# Houston Univ., Tex. Dept. of Chemistry
GAS CHROMATOGRAPH-QUADRUPOLE MASS SPECTROMETRIC ANALYSIS OF ORGANIC COMPOUNDS
W. S. Updegrove, J. Oro, and A. Zlatkis [1966] 15 p refs Submitted for Publication
(Grants NGR-44-005-020; NGR-44-005-043)
(NASA-CR-81760) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Chromatographic and mass spectral data on the analysis of a sample consisting of acetonitrile, furan and pyrrole are presented. Other samples of aromatic hydrocarbons, paraffins and organic compounds of biological significance were also analyzed. Mass spectra of individual components in samples of a few micrograms were obtained without the use of molecular separators. The apparatus yielded results which were equivalent but not identical to that obtained from an LKB 9000 instrument which was used as a standard for comparison. The data obtained with compounds of mass below 150 are reliable and promising results were also obtained with compounds of mass up to 500. Author

N67-18107# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
METHODS FOR ANALYSIS OF ORGANIC COOLANTS (A SUMMARY OF CURRENT CANADIAN PRACTICE)
R. B. Stewart and J. L. Smee May 1966 21 p refs Presented at IAEA Panel on the Use of Organic Liquids as Reactor Coolants and Moderators, Vienna, 9–13 May 1966
(AECL-2643) CFSTI: HC $3.00/MF $0.65

Methods currently used in Canada for the analysis of terphenyl reactor coolant mixtures are described. Major constituents, physical properties, impurities, radioactivities and coolant quality tests are considered. While the procedures outlined are generally satisfactory, comments are made as to the desirable objectives in further analytical method development for these materials. These include emphasis on continuous in-line measurements of fouling, physical properties, gases, and radionuclides. Author

N67-18121*# Miami Univ., Fla. Inst. of Molecular Evolution.
SYNTHESES OF OPTICALLY ACTIVE α-AMINO ACIDS FROM α-KETO ACIDS BY HYDROGENOLYTIC ASYMMETRIC TRANSMINATION
Kaoru Harada [1966] 7 p refs Submitted for Publication *Its* Contrib. No. 071
(Grant NsG-689)
(NASA-CR-81779) CFSTI: HC $3.00/MF $0.65 CSCL 06A

During advanced studies on the nonenzymatic synthesis of optically active amino acids from their corresponding α-keto acids, laboratory hydrogenolysis was conducted. It was found that sodium phenylglycinate in aqueous solution was hydrogenolyzed easily to ammonia and phenylacetic acid by the use of palladium on charcoal, palladium hydroxide on charcoal, or by other catalysts. The synthesis is shown that various α-amino acids from their corresponding α-keto acids and optically active D and L-phenylglycine in aqueous solution. By this synthetic method, 40–60% optically active α-amino acids were usually obtained. R.Ll.

N67-18123* George Washington Univ., Washington, D.C.
ORGANIC SYSTEMS INVOLVING TRANSITION METALS FOR LASER MATERIALS Semiannual Report, Jul. 1–Dec. 31, 1966
N. Filipescu 31 Dec. 1966 5 p
(Grant NsG-603)
(NASA-CR-81780) CFSTI: $3.00 CSCL 07C

Sensitive rare earth fluorescence in organic solvents, and the synthesis of model compounds and quantitative studies of intramolecular energy transfer are investigated in relation to development of organic laser materials. Migration of excitation energy from organic chromophores to rare earth ions results from an organic sensitizer, and lanthanide ion collision in solution occurs in which both the ion and sensitizer are nonassociated solutes. Characteristic three positive Eu, Tb, Dy, or Sm fluorescence is observed on excitation; fluorescence quantum efficiencies approaching unity were determined for the Tb and Eu acceptors. Results with no sensitizer other than the lanthanide ions should enable the establishment of efficient combinations for liquid laser materials; and larger diameter laser cells can be used than with chelates that must be surrounded by four ligand groups. The synthesized models have two different chromophores that are connected through a rigid inert molecular frame in which mutual orientation and distance of separation between chromophores is different. M.W.R.

N67-18146*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IONIC CONDUCTIVITY OF CALCIUM AND STRONTIUM FLUORIDES

William L. Fielder. Washington, NASA, Feb. 1967. 23 p refs
(NASA-TN-D-3818) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The conductivities of single crystals of calcium and strontium fluoride were determined. In the extrinsic region, the specific conductivity of each crystal may differ. The extrinsic conductivities for the normal process of point-defect migration for two CaF_2 crystals between 430° and 535°C are given, as well as the extrinsic conductivity of SrF_2 between 360° and 410°C. Only one intrinsic region was observed for two CaF_2 crystals between 645° and 830°C or for SrF_2 between 580° and 760°C. The thermally produced defects, responsible for the conductivity of these fluorides in the intrinsic region, are suggested to be fluorine ion vacancies. Finally, activation energy requirements were related to the energies of migration and formation. The primary mechanisms consistent with the results are the formation and migration of fluorine ion vacancies. For the intrinsic region, fluorine ion vacancies in calcium and strontium fluorides are formed thermally with a formation energy of 60.0 and 51 kilocalories, respectively, for the Frenkel pair. For the extrinsic region, these vacancies are formed, predominantly, by means of monovalent impurities. Migration of these vacancies in the fluorides of calcium and strontium occurs with energies of 16.5 and 17.4 kilocalories, respectively. Author

N67-18161*# Rocketdyne, Canoga Park, Calif.
PROPERTIES OF NONAQUEOUS ELECTROLYTES Quarterly Report, 20 Sep.–19 Dec. 1966
Rudolf Keller, James N. Foster, and James D. Ray, and Jack M. Sullivan. 19 Dec. 1966. 72 p refs
(Contract NAS3-8521)
(NASA-CR-72168; R-6754-2; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A complete vapor phase chromatographic analysis of dimethyl formamide was conducted, and several techniques were utilized to verify the water content of propylene carbonate and dimethyl formamide. Solutes were characterized by spark source mass spectrometry and emission spectroscopy. Physical properties such as the density, viscosity, and conductance of electrolytes containing LiCl and/or $AlCl_3$ in dimethyl formamide were determined. Author

N67-18182# National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, JULY–AUGUST 1966
J. J. Diamond, ed. Sep. 1966. 67 p refs *Its* No. 3

A bibliography is presented which deals with devices for achieving, measuring, and controlling temperatures above 1500°C, and devices for physical measurements at temperatures above 1000°C. Also included are literature on metallic, nonmetallic, and mixed materials properties, phase equilibria, and reactions at temperatures above 1000°C. A.G.O.

N67-18184# National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer, comp. (Calif. Univ., Berkeley). 30 Sep. 1966. 34 p refs *Its* No. 20

A bibliography on spectroscopy of interest to high temperature chemistry and on reactions between gases and condensed phases is presented. C.T.C.

N67-18194*# General Electric Co., Schenectady, N. Y. Chemical and Materials Engineering Lab.
STUDY OF ADDITIVES TO IMPROVE NICKEL HYDROXIDE ELECTRODE BEHAVIOR Final Report
W. N. Carson, Jr. 15 Mar. 1964. 79 p refs
(Contract NAS5-3349)
(NASA-CR-53885) CFSTI: HC $3.00/MF $0.65 CSCL 07B

This report describes the work and results of an investigation on the use of spinel additives to nickel hydroxide electrodes. The objective of the investigation was to determine if one or more of these additives would give nickel hydroxide electrodes with improved reversibility on charge and discharge. With the exception of scandium, no marked effect on reversibility was found, the scandium appears to decrease the overall utilization and is thus unattractive as an additive. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-16724*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMMUNICATION SYSTEMS RESEARCH AT MSFC
John G. Gregory, Carl T. Huggins, and Paul M. Swindall. 1966. 29 p refs *Its* Res. Achievements Rev. Ser. 18
(NASA-TM-X-53535) CFSTI: HC $3.00/MF $0.65 CSCL 09F

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1. HYDROGEN MASER RESEARCH ACHIEVEMENTS AT MSFC J. G. Gregory p 1–8 refs (See N67-16725 07-16)

2. DEVELOPMENT OF A SOLID-STATE IMAGE CONVERTER C. T. Huggins p 9–12 (See N67-16726 07-14)

3. PROPAGATION STUDIES P. M. Swindall p 13–18 (See N67-16727 07-07)

N67-16727*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROPAGATION STUDIES
Paul M. Swindall *In its* Commun. Systems Res. at MSFC 1966 p 13–18 (See N67-16724 07-07) CFSTI: HC $3.00/MF $0.65

A method for increasing the accuracy of telemetry signal strength predictions is discussed. The systems considered are novel in that they have dc-to-20kHz signal strength recording responses. They make simultaneous phase coherent recordings of right circular, left circular, vertical, and horizontal polarizations. Research will continue in an effort to resolve propagation anomalies in preparation for manned vehicles. Author

N67-16796*# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.
SOME EFFECTS OF INTER-ELEMENT CORRELATION AND CLIPPING ON THE PERFORMANCE OF RECEIVING ARRAYS
C. Nicholas Pryor. 19 Sep. 1966. 126 p refs
(NOLTR-66-53; AD-642770) CFSTI: HC $3.00/MF $0.65

The paper discusses some aspects of the performance of receiving arrays in the presence of non-uniform and correlated background noise, for both linear and clipped processing techniques. Examples are used to illustrate correlation between receivers with finite spacing and the effect of this correlation on line, planar, and spherical arrays. Some effects of clipped processing in non-uniform noise environments are also discussed. Author (TAB)

N67-16836# Polytechnic Inst. of Brooklyn, N. Y.
SLOT ANTENNA IN A PLASMA
S. Gaglione *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 85–95 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

An experiment was conducted to study the effect of a plasma environment on a slot antenna. Emphasis is placed on the cylindrical cathode discharge which produces a uniform plasma of sufficient density to cut off S-band transmission. Major areas covered include the anode modification of a cylindrical cathode discharge, the measurement of electron density by double Langmuir probes, pulsed operation of cylindrical cathode discharge, and the slotted cavity and waveguide fed slot designs for the antenna. C.T.C.

N67-16846# Polytechnic Inst. of Brooklyn, N. Y.
THE RAY-OPTICAL FIELDS OF A POINT SOURCE IN BOUNDED ANISOTROPIC MEDIA
H. L. Bertoni and A. Hessel *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 171–192 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65
(Contract AF 19(628)-2357)

The excitation of electromagnetic fields by an arbitrary point source in the presence of bounded anisotropic media when no simplifying symmetries are present is considered. Analyses are made of the direct, reflected, transmitted, and lateral ray contributions to the far fields radiated by a point source in the presence of a planar interface between two arbitrary, lossless, and anisotropic media. In considering the far fields a ray-optical formalism is developed. Starting with a rigorous Fourier integral representation, it is demonstrated that the far fields can be obtained directly by a ray-optical calculation involving only the knowledge of the radiation fields in unbounded media and the plane wave scattering properties of the interface. The expressions contain only physically significant factors such as source excitation coefficients, plane wave scattering coefficients, ray lengths, ray phases, and ray divergence coefficients. The ray-optical form exhibits explicitly the local nature of ray propagation, and permits an extension of the planar interface results to other geometries which are not amenable to a rigorous modal treatment. C.T.C.

N67-16931*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
[THEORETICAL AND EXPERIMENTAL STUDIES OF SUB-OPTIMAL SECOND AND THIRD GENERATION SELF-ADAPTIVE BINARY COMMUNICATION SYSTEMS] Semiannual Report, Jul. 1–Dec. 31, 1966
John C. Lindenlaub 31 Dec. 1966 32 p refs
(Grant NSG-553)
(NASA-CR-81438) CFSTI: HC $3.00/MF $0.65 CSCL 09D

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5. A PHASE LOCK LOOP SYSTEM WITH A MODULO $2n\ \pi$ PHASE DETECTOR J. C. Lindenlaub and D. P. Olson p 10–14 (See N67-16933 07-07)
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7. USE OF CHANNEL SIMULATOR D. R. Anderson and S. E. Nykanen p 17
8. SIGNAL DEBLURRING C. D. McGillem and S. S. C. Yao p 17–20 (See N67-16935 07-07)

N67-16932*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
DIGITAL SIMULATION OF A RANDOMLY TIME-VARIANT COMMUNICATION CHANNEL
J. C. Lindenlaub and C. C. Bailey *In its* Theoret. and Exptl. Studies of Sub-Optimal Second and Third Generation Self-Adaptive Binary Commun. Systems 31 Dec. 1966 p 5–9 refs (See N67-16931 07-07) CFSTI: HC $3.00/MF $0.65

The assumptions used in simulating the channel model are listed, and it is reported that the simulation system was applied to the case of tropospheric scatter communication channel. The channel correlation data are given, along with the parameter values used in the simulation. Experimental measurements of $R_H(\Omega,O)$, and $R_H(O,\delta)$ were made; figures showing the theoretical and experimental graphs for each are included. M.G.J.

N67-16933*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
A PHASE LOCK LOOP SYSTEM WITH A MODULO $2N\ \pi$ PHASE DETECTOR
J. C. Lindenlaub and J. J. Uhran *In its* Theoret. and Exptl. Studies of Sub-Optimal Second and Third Generation Self-Adaptive Binary Commun. Systems 31 Dec. 1966 p 10–14 (See N67-16931 07-07) CFSTI: HC $3.00/MF $0.65

As part of the continuing efforts to determine the effects of phase detector characteristics on phase lock loop design parameters, a study was initiated on a phase lock system with a phase detector characteristic that is linear and periodic with period $2n\pi$ radians instead of the usual 2π radians. The threshold behavior of the modulo $2n\pi$ system is considered of particular interest. Expected performance is outlined. A phase lock loop using this type phase detector ($n = 2^i$, $i = 1$ to 9) is being constructed. A block diagram of the system is presented, and keyed to the explanatory text. M.G.J.

N67-16934*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
M-ARY SIGNAL SETS FOR SCATTER-MULTIPATH AND OTHER ASYNCHRONOUS COMMUNICATION
D. R. Anderson *In its* Theoret. and Exptl. Studies of Sub-Optimal Second and Third Generation Self-Adaptive Binary Commun. Systems 31 Dec. 1966 p 15–16 refs (See N67-16931 07-07) CFSTI: HC $3.00/MF $0.65

A few studies pertaining to the condition for optimality in the case of M-ary signal sets are briefly reviewed. A method of using shift register sequences to obtain constant envelope p-ary signal sets for every prime p and every $n \geq 1$ is also reported. M.G.J.

N67-16935*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
SIGNAL DEBLURRING
C. D. McGillem and S. S. C. Yao *In its* Theoret. and Exptl. Studies of Sub-Optimal Second and Third Generation Self-Adaptive Binary Commun. Systems 31 Dec. 1966 p 17–20 (See N67-16931 07-07) CFSTI: HC $3.00/MF $0.65

Some examples are given to illustrate the problem involved in recovering the original signal by suitable processing of the blurred signal; in these cases, the exact nature of the blurring is

known. Two approaches to deblurring methods are mentioned: (1) The reciprocal of the transform of the blurring function is approximated by various infinite series. (2) The integral equation for particular blurring functions (kernels) is solved by working in the time domain. M.G.J.

N67-16983# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.

ANALYSIS OF DIGITAL COMMUNICATION SYSTEMS ON TROPOSPHERIC SCATTER

Robert G. McLaughlin *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 14 p (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

This paper discusses three time-modulation-multiplex communication systems, the mathematical models and analysis, and presents the theoretical and experimental results. The Sunde model of troposcatter is used to compute one performance measure, called the error probability, for each system. The model describes the effects of troposcatter on signals in terms of statistics. For each system, the final result is a curve of error probability versus the received average signal-to-noise ratio. The curve for each system shows how well that system will work on a specific communication circuit. Pulse distortion limits the performance of each system, no matter how large the signal-to-noise ratio is made. Theoretical results were compared with the test results for each system and found in excellent agreement. The tests also showed performance limits at high signal levels, and the test limits were very close to the predicted limits. Author

N67-17002# Columbia Univ., New York. Dept. of Electrical Engineering.

PERTURBATION THEORIES FOR NONUNIFORM ELECTROMAGNETIC STRUCTURES

S. L. Richter and P. Diament *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 1-3 refs (See N67-17001 07-25) CFSTI: HC $3.00/MF $0.65

The development of an analysis for axially dependent perturbations on otherwise axially uniform structures, based on an adaptation of the time dependent perturbation theory of quantum mechanics, is briefly reviewed. Generalizations and variations of this basic analysis are also discussed, and additional studies planned to extend the usefulness of the perturbation techniques are delineated. L.E.W.

N67-17004# Columbia Univ., New York. Dept. of Electrical Engineering.

DISPERSION RELATIONS FOR GENERAL ELECTROMAGNETIC PROPAGATING AND RADIATING STRUCTURES

S. L. Richter *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 5-6 (See N67-17001 07-25) CFSTI: HC $3.00/MF $0.65

Some preliminary results are reported, which were obtained in the investigation of dispersion relations for linear, time-invariant, lossless structures, uniform along the direction of propagation and piecewise uniform in the transverse plane. These results concern conditions for backward waves on structures having scalar, positive, real constitutive parameters. It was found that there are no backward TE or TM waves on such a structure, and a necessary and sufficient condition for the existence of backward waves is that the energy stored in longitudinal fields exceed that stored in transverse fields. Also, a physical picture of the process involved in the transmission of backward waves was formulated, whereby the opposite signs of the phase and energy velocities arise because of the existence of a spatially constant component of energy or power which exceeds the oscillating component but has opposite sign. L.E.W.

N67-17005# Columbia Univ., New York. Dept. of Electrical Engineering.

TRANSMISSION AND RADIATION PROPERTIES OF THE V-LINE

P. Diament, S. L. Richter, W. L. Lupatkin, R. Rennick, and E. Rotholz *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 7-9 refs (See N67-17001 07-25) CFSTI: HC $3.00/MF $0.65

A summary report is given of research conducted on the transmission and radiation properties of the V-Line, including brief details on objectives, procedures, and results. The research described includes calculations of the attenuation coefficients for a surface wave propagating though a V-Line having lossy walls and lossy binding media; experiments on a V-Line with a ferroelectric binding medium; the radiating properties of a V-Line converted into an end-fire or broadside radiator; the feasibility of scanning broadside radiation from a periodically loaded V-Line, where the parasites, and not the binding medium, are tuneable elements; and the proper and improper modes of surface waves on the V-Line. L.E.W.

N67-17093# Naval Ordnance Lab., Corona, Calif.

RADAR HOLOGRAMS

Robert L. Conger, Leslie T. Long, and John A. Parks 30 Sep. 1966 21 p refs

(NOLC-677; AD-640262) CFSTI: HC $3.00/MF $0.65

Optical experiments and mathematical analysis of radar patterns have shown that radar holograms which are not affected by vibration can be obtained by the following method: (1) A scanning radar receiver--possibly airborne--or an array of such receivers is used to produce a map that shows the intensities of radar signals; (2) a pattern of concentric black and white bands is developed--possibly by a computer--in which the width of each band is proportional to the cube root of its respective radar signal intensity; (3) the photographically reduced pattern is made into a transparency which is the hologram; and (4) the hologram is illuminated by coherent light to provide images of the objects that caused the original radar signal distribution. This method produces holograms which are superior to Fresnel holograms, in that vibration is not a factor and, because exact gray scales are not required, to Fraunhofer holograms. Author (TAB)

N67-17113 Hughes Aircraft Co., Culver City, Calif. Antenna Dept.

SURVEY OF SIGNAL PROCESSING ARRAYS

A. Ksienski [1966] 45 p refs Presented at the AGARD Avionics Panel 12th Symp. on Radio Antennas for Aircraft and Aerospace Vehicles and Signal Process. Arrays, Duesseldorf, 7 Jul. 1966 (PUB-171)

Signal processing arrays are reviewed, including a literature survey and a critique. A signal processing array is defined as an array of antennas whose outputs are processed in the best way for a specific system objective. The specific types of signal processing arrays discussed include synthetic arrays, self-phasing and retrodirective arrays, correlation arrays, and decision theoretic arrays. Author

N67-17187*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ON THE APPLICATION OF EXTREME-VALUE STATISTICS TO COMMAND ORIENTED PROBLEMS

John C. Ashlock and Sandra M. Lurie 15 Oct. 1966 116 p refs

(Contract NAS7-100)

(NASA-CR-81521) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Consideration is given to the problem of experimentally estimating or verifying error probabilities when the classical error

counting approach is too time consuming to use. The rudiments of extreme value theory are introduced for the univariate case where the bit error probability of interest depends on a single variable, and for the bivariate case where the bit error probability is a function of two dependent variables. Many examples are given, and numerical results are presented. Considerable attention is given to techniques of implementing the theory. . . . Author

N67-17174# Sylvania Electric Products, Inc., Waltham, Mass.
NONSUPERVISED ADAPTIVE DETECTION FOR MULTIVARIATE NORMAL DISTRIBUTIONS Final Technical Report, Feb. 1965–Apr. 1966
Paul W. Cooper Griffiss AFB, N. Y., RADC, Sep. 1966 84 p refs
(Contract AF 30(602)-3619)
(RADC-TR-66-488; AD-640494) CFSTI: HC $3.00/MF $0.65

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1. NONSUPERVISED ADAPTATION p 6–10
2. TWO-CATEGORY CASE WITH GENERAL UNEQUAL CONVARIANCE MATRICES p 11–28
3. MULTIPLE-CATEGORY CASE p 29–51 refs

APPENDIXES

4. NON-SUPERVISED ADAPTIVE DETECTION P. W. Cooper 22 p (See N67-17175 07-07)

N67-17175# Sylvania Electric Products, Inc., Waltham, Mass.
NON-SUPERVISED ADAPTIVE DETECTION
Paul W. Cooper *In its* Nonsupervised Adaptive Detection for Multivariate Normal Distributions Sep. 1966 61 p (See N67-17174 07-07) CFSTI: HC $3.00/MF $0.65

In the definition given for nonsupervised learning, the identification of the signals is not known separately, and the receiver must do all of its learning solely on the basis of its examination of the received samples. Attention is directed primarily to the case where there is any amount of overlap (as in the case of the upper quadrant). The approach taken is illustrated by the two-category case, i.e., binary signalling alphabet with equal prior probabilities. Two fundamental questions are cited for nonsupervised adaptation: structure, and estimation (learning). The problem is viewed as one in which the received signals are considered to be drawn from a population having an overall bi-modal probability distribution. M.G.J.

N67-17193# Air Force Cambridge Research Labs., Bedford, Mass.
THE MULTIPLATE ANTENNA
Allan C. Schell, Peter R. Franchi, William B. Goggins, and George R. Forbes Aug. 1966 62 p refs *Its* Instrumentation Papers No. 111
(AFCRL-66-535; AD-642430) CFSTI: HC $3.00/MF $0.65

The multiplate technique is a method of antenna design that is intended to allow the economical construction of very large antennas. The aperture area is divided into a large number of reflectors that can be adjusted in orientation and height. These plates are positioned so that energy from a desired direction is redirected to add at the focus. In this paper an analysis of the effects caused by the interstices in a multiple plate antenna is presented. The loss due to gaps and shadowing, the variation in effective receiving cross section, and the radiation pattern are determined. The bandwidth properties of this type of antenna are analyzed, and methods for reducing the effect of frequency dispersion on the pattern are presented. A short discussion of the components of a 2500-ft multiplate antenna is included. An experimental program of measurement has determined the radiation pattern, the efficiency and the relative change of gain and antenna temperature versus beam angle of a test section of a multiplate antenna. The effect of the interstices in the reflecting surface produced grating lobes of approximately -20 dB and an additional temperature component that varied from 20K - 65K depending on the beam angle. Author (TAB)

N67-17232# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DIRECTIVITY OF AN ARRAY OF SLOTS ON THE SURFACE OF A CYLINDER
Leon J. Ricardi 10 Oct. 1966 39 p refs
(Contract AF 19(628)-5167)
(TN-1966-52; ESD-TR-66-451; AD-641959) CFSTI: HC $3.00/MF $0.65

General expressions for the directivity of arrays of axial and circumferential slots on an infinite conducting cylinder are derived. Directivity patterns of uniformly excited arrays of several slot configurations are presented. The optimum spacing for 2, 3, 4, 5, 6, and 7 slot arrays on an infinite cylinder between one and four wave-lengths in diameter is presented and the minimum number of slots required to produce a uniform pattern in the equatorial plane is determined. Author (TAB)

N67-17237# Lincoln Lab., Mass. Inst. of Tech., Lexington.
APPLICATION OF TRANSVERSAL EQUALIZER TO RADAR RECEIVER WITH EMPHASIS ON DOPPLER SENSITIVITY
R. C. Yost and E. B. Smith (Radio Corp. of Am.) 23 Jun. 1966 24 p refs
(Contract AF 19(628)-5167; ARPA Order 600; Proj. Defender)
(TR-420; ESD-TR-66-243; AD-640892) CFSTI: HC $3.00/MF $0.65

There is a basic constraint imposed on radar measurements when the transmitted signal is a simple, cw pulse. As a result, the radar designer may wish to use a more complex signal and thereby extract more information from an echoing object. Unfortunately, the processed returns of the sophisticated waveforms usually consist of a peak response and small adjacent responses (called 'time sidelobes') which degrade the resolving capability of the radar. One means of reducing the sidelobes is to use a transversal equalizer in the radar receiver. A mathematical model of the equalizer is presented and the sensitivities of an equalized system to uncompensated Doppler frequency shifts are computed. It is shown that the Doppler frequency band over which the equalizer is effective decreases as (1) the signal bandwidth decreases, (2) the distances of the large sidelobes from the main pulse increase, and (3) the magnitudes of the uncompensated sidelobes increase. Testing the equalizer in a highly sensitive, tracking radar indicates that sidelobes 40 dB below the main response can be obtained for a fixed Doppler frequency shift. Experimental data illustrating the stability of an equalized system in the presence of a Doppler shift show that, for a typical pulse-compression system, the equalizer utility is generally confined to situations where the frequency shift is within plus or minus 2 percent of the signal bandwidth. Author (TAB)

N67-17262# RAND Corp., Santa Monica, Calif.
RADAR SIGNATURE ANALYSIS OF EXTENDED TARGETS
P. Swerling Oct. 1966 63 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5134-PR; AD-642713) CFSTI: HC $3.00/MF $0.65

A Bayes approach to parameter estimation, based on the minimum mean square error criterion, applied to the problem of identifying such radar target characteristics as dimensions, shape, rate of rotation, and axis of rotation, as well as the more usually considered range, range rate, and range acceleration. Emphasis is on estimation of linear or quadratic functionals of the scatterer

amplitudes, such as the average scattering cross section attributable to specific regions of the target. Theoretically, results can be obtained for nonstationary cases, such as those involving specular flashes, for any signal-to-noise ratio, and for any degree of prior knowledge of target characteristics. However, most cases require solution of certain integral equations for which the computer programs are as yet unwritten. Initial steps toward computer implementation are discussed. Applications include satellite identification, radar astronomy, and radar ground mapping.
Author (TAB)

N67-17254# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.

PROPAGATION OF VLF WAVES BELOW AN ANISOTROPIC STRATIFIED IONOSPHERE WITH A TRANSVERSE STATIC MAGNETIC FIELD

Janis Galejs Nov. 1966 42 p refs
(RR-515; AD-642511) CFSTI: HC$3.00/MF$0.65

The surface impedance of a cylindrically stratified anisotropic ionosphere has been computed in the presence of a transverse static magnetic field without requiring explicit representations of the individual cylindrical wave functions in the lower ionospheric layers. The propagation parameters are determined from the usual transcendental modal equation which is solved starting out with an initial real solution dependent on the reactive part of the ionospheric surface impedance. The surface impedance computations are continued below the ionospheric boundary height and the impedance reflected to the ground level by the ionosphere is compared with the ground impedance. The accuracy of the modal equation is shown to be comparable to a few percent uncertainty of the ground impedance for low conductivity ground. The propagation parameters of the first three waveguide modes are calculated for a number of ionosphere models which include the recent D-region models of Deeks. For propagation in the east to west direction, the phase velocity of the second mode is shown to be discontinuous when the real part of the ionospheric reflection coefficient undergoes a sign change. Author (TAB)

N67-17273# Philco Corp., Palo Alto, Calif.

DEMODULATION OF ANGLE-MODULATED TELEMETRY SIGNALS. VOLUME I: ADVANCED DEMODULATION TECHNIQUES

D. D. Luby, E. J. Ballard, W. J. Gill, and J. J. Spilker, Jr. May 1966 250 p refs
(Contract AF 19(628)-5203)
(WDL-TM-101; ESD-TR-66-408, Vol. I; AD-639787) CFSTI: HC $3.00/MF$0.65

A great deal of study has been given to the demodulation of FM and PM modulated signals. This report is the first of a two-volume series which reviews and contributes to the body of information on this subject. In this volume, three new techniques are discussed which are useful for the demodulation of angle-modulated signals. The three techniques analyzed are: (1) nonlinear post-detection filtering, (2) subharmonic phase-locked loop, and (3) feedforward deviation compression demodulator. The performance of these techniques is analyzed both with respect to noise effects and distortion. Emphasis is given to telemetry signal processing. Several computer (digital) programs were generated to carry out these investigations and nonlinear post-detection filters were simulated on an analog computer. In addition to the three new techniques studied in this report, several other topics are treated. One important topic is a precise analysis of the distortion in phase-locked loops. The second is a review of the effects of predetection recording on telemetry signals. Author (TAB)

N67-17280# Aeronautical Research Council (Gt. Brit.)

A THEORETICAL TREATMENT OF NOISE AND NON-LINEARITIES IN A BEAM-RIDING SYSTEM

E. G. C. Burt Nov. 1951 39 p ref
(ARC-R&M-3417; AD-800225) CFSTI: HC$3.00/MF$0.65

The effectiveness of a beam-riding missile is greatly influenced by the mutual effect of noise and non-linearities. The former is mostly due to radar jitter, while the principal non-linearity is that introduced by limiting to lateral acceleration of the missile to a safe value. For the beam-riding system discussed in this paper the degree of saturation is such that the linear analysis is inadequate and account must be taken of the non-linearity. With certain assumptions, the system can be described analytically; further approximations lead to optimum values of the disposable parameters for obtaining the minimum miss distance. The analysis shows that, while optimum values of the parameters can be specified for a restricted class of target trajectories, a more detailed study of likely target manoeuvres is necessary before an overall optimum can be defined. Author (TAB)

N67-17348# Aeronautical Research Council (Gt. Brit.)

ON THE STATISTICAL OPTIMIZATION OF GUIDED-WEAPON SYSTEMS

E. G. C. Burt and R. W. Bain London, HMSO, 1966 109 p refs
(ARC-R&M-3418) CFSTI: HC$3.00/MF$0.65

The statistical nature of the input to a guided-weapon system (target information and noise) requires that the criterion of weapon performance be itself a statistical quantity. The criterion used in this paper is the mean square miss distance, the mean being taken over a large number of engagements, such that all probable target and noise inputs are encountered, and it is shown that there exists an optimum realisable system for which this mean square miss distance is a minimum. Explicit formulae are derived for cases in which the noise spectral density is assumed to be constant with frequency, and the target manoeuvres to be such that their lateral accelerations form a stationary ensemble over the necessary interval. The examples given show that a definite improvement results from the use of the optimum system, in that both the miss distance and the acceleration requirements are reduced. It is concluded that the missile accelerations required to achieve a given miss distance are considerably less than those hitherto considered necessary. Author

N67-17349 Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Groupe de Recherches sur la Fusion Controlee.

STUDY AND REALIZATION OF A HIGH FREQUENCY ANALYZER [ETUDE ET REALISATION D'UN ALAYSEUR DE SIGNAUX A HAUTE FREQUENCE]

J. Bourbigot Brussels, EURATOM, Nov. 1966 62 p In FRENCH; ENGLISH summary
(Contract EURATOM-007-62-1 FUAF)
(EUR-2701.f; CEA-R-2942) CFSTI: HC$3.00/MF$0.65

This device is designed for the amplitude and frequency analysis of electric or electromagnetic signals in the frequency range of 0 to 55 MHz. The frequency spectrum of a preset bandwidth is displayed on the screen of an oscilloscope. Conceived to analyze the electromagnetic oscillations that can be generated in a plasma. Its main characteristics are the following: extended bandwidth of analyzed frequencies, on both sides of the ion cyclotron frequency in a magnetic field up to 20 kGs, linear amplitude and frequency response, possibility of analyzing a narrow band, high sensitivity, and analysis repetition rate of 25 per second. The different parts of the analyzer are described after a discussion of the choice of

the techniques used in their design. In addition to its present use, the device can be applied to perform all the functions of a commercial spectral analyzer. Author

N67-17632*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
SINGLE PARAMETER TESTING Quarterly Report
E. L. Berger, C. A. Grunden, and J. T. Sterling Feb. 1967 57 p refs
(Contract NAS8-11715)
(NASA-CR-61164) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Test signals, AC analysis, transfer function determination, and nonlinear component parameters are considered for single parameter testing that will permit faster checkout time of an amplifier. Simpler to generate test signals were found to result in good parameter predictions, and the accuracy of these predictions was increased by using second order terms to represent the difference signal between the reference system and the tested system. Transfer function of the AC amplifier was found to have a seventeenth order denominator and a twelfth order numerator, and a digital program was written to determine transfer functions from magnitude and phase input data. It was found that parameter measurements could be made of a nonlinearity represented by a polynomial, and by a limiter and deadband nonlinearity. M.W.R.

N67-17637*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EVOLUTION OF THE SATELLITE TRACKING AND DATA ACQUISITION NETWORK (STADAN)
William R. Corliss Jan. 1967 80 p refs
(NASA-TM-X-55658; X-202-67-26; GHN-3) CFSTI: HC $3.00/MF $0.65 CSCL 09F

An overview is presented of the evolution of NASA's scientific satellite tracking facilities, particularly the development of STADAN, the Satellite Tracking and Data Acquisition Network. Pre-IGY (International Geophysical Year) developments are discussed; as are the Minitrack concept, the so-called four years of stability from 1958 through 1962, and the metamorphosis of Minitrack into STADAN. Vignettes describe both Minitrack and STADAN stations, and a history of major equipment changes at STADAN stations is included. M.W.R.

N67-17665# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSE RADAR
Ya. D. Shirman 14 Jul. 1966 8 p Transl. into ENGLISH from Russian Patent no. 152487 (Appl. no. 03178/700109, 21 Nov. 1955) 3 p
(FTD-TT-65-1741; AD-643730) CFSTI: HC $3.00/MF $0.65

The object of the invention is pulse radar which has the distinguishing characteristic that for the purpose of improving the resolving capacity in its basic, or supplementary receiving devices, there are used videofrequency linear accelerators with the application of double synchronous detection. Pulse radar in accordance with Par. 1, which has the distinguishing characteristic that in its basic, or supplementary receiving devices, high-frequency linear accelerators are used - sections of a long line, the time of retardation in which is multiple to the period of high frequency, which are made up from a section matched on the input and shortened at the end, or of a combination of sections that are matched at the input and open at the end. Author (TAB)

N67-17677# Vitro Labs., West Orange, N. J.
DEVELOPMENT OF DIGITAL COMMUNICATION EQUIPMENT TEST SET AN/GYM-4 ( ) Final Report, Jul. 1966–Oct. 1966
Seymour I. Finkel and Donald J. Walker Oct. 1966 125 p refs
(Contract DA-28-043-AMC-00327(E))
(VL-2378-6-0; Rept.-6; AD-640994) CFSTI: HC $3.00/MF $0.65

Test Pattern Generator SG-600( )/GYM-4 and Digital Signal analyzer TS-2129()/GYM-4 were developed and designed in accordance with Electronics Command Technical Requirement SCL-7744B. Two models were fabricated and subjected to performance and environmental tests. Four additional models were then fabricated and performance tested. Several mechanical and electrical deficiencies were encountered during environmental tests. After minor modifications were made, all specification requirements were satisfied. The equipment was fully documented. This includes manufacturing drawings, photographs, repair parts lists, and operating and maintenance manuals. Author (TAB)

N67-17678# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experimental Center.
VHF TRANSCEIVERS FOR LOW-ACTIVITY AIR TRAFFIC CONTROL TOWERS Final Report
Albert V. Lolli Jun. 1966 46 p
(FAA-RD-66-38; AD-642716) CFSTI: HC $3.00/MF $0.65

Laboratory, operational, and subjective tests were performed to determine performance capability and to investigate the communications coverage area of a solid-state, low-powered (one watt) transceiver for air traffic control communications at low-activity/low-cost air traffic control facilities and as possible emergency backup equipment, with self-contained antenna, for operation within the cab of airport control towers. Results of the test effort indicated that it was feasible to use low-powered transceivers and standard FAA antennas to provide ATC communications at low-activity ATCT's. Additionally, it was determined that adequate communications coverage, with negligible antenna pattern deterioration, was obtained when the low-powered transceiver and self-contained whip antenna were operated inside a tower cab. The report contains recommendations to develop a low-powered, portable, all solid-state transceiver, designed to operate on primary power and self-contained rechargeable batteries. Author (TAB)

N67-17740# Hanovia Lamp Div., Engelhard Industries, Inc., Newark, N. J.
IMPROVEMENT OF COMMUNICATION ARC LAMPS FOR VISIBLE AND INFRARED SIGNALLING EQUIPMENT Progress Report, 1 Apr.–31 Aug. 1966
M. Skal 31 Aug. 1966 16 p
(Contract NObsr-93090)
(PR-3; AD-641399) CFSTI: HC $3.00/MF $0.65

A prototype self-starting 300 watt xenon lamp was developed and the first test results are reported. TAB

N67-17760# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADAR EQUIPMENT FOR POLARIZATION INVESTIGATIONS OF CLOUDS AND PRECIPITATION [RADIOLOKATSIONNAYA APPARATURA DLYA POLYARIZATSIONNYKH ISSLEDOVANIY OBLAKOV I OSADKOV]
S. P. Morgunov, G. P. Trifonov, and A. B. Shupyatskiy 21 Nov. 1966 15 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 48, 1963 p 106–111
(FTD-MT-65-303; TT-64-51933; AD-643641) CFSTI: HC $3.00/MF $0.65

Polarization methods for the analysis of echoes from clouds and precipitation have been developed recently. This article describes a radar apparatus which can be used to investigate the polarization characteristics of echoes from clouds and precipitation. The Laboratoriya radiolokatsii Tsentralnoy aerologicheskoy observatorii

(Radar Laboratory of the Central Aerological Observatory) has developed a two-antenna radar set with a fixed beam and variable polarization of the signal. The system can transmit and receive echoes with linear, circular, or elliptical polarization. The block diagram of the set is shown in Fig. 1 of the Enclosure. The outfit is based on a modern 3-cm high-potential radar set. TAB

N67-17779*# Illinois Univ., Urbana. Antenna Lab.
A STUDY OF SELECTED RADIATION AND PROPAGATION PROBLEMS RELATED TO ANTENNAS AND PROBES IN MAGNETO-IONIC MEDIA Semiannual Progress Report, 1 Oct. 1965–31 Mar. 1966
31 Mar. 1966 20 p refs
(Grant NsG-395)
(NASA-CR-71378; SAPR-6) CFSTI: HC $3.00/MF $0.65 CSCL 20N

Brief summaries of research related to radiation and propagation problems associated with antennas and probes in magnetoionic media. Topics include: impedance of an electric current loop in an anistropic cold plasma, experimental measurement of loop impedance in a magnetoplasma, and wave propagation in plasmas with strong magnetic fields. Also described is current distribution and input admittance of a cylindrical antenna, anistropic waveguides, and circular waveguides partially filled with warm plasma. Reciprocity, equivalence, and Huygen's principle in a compressible magnetoplasma, and antenna radiation comprise the final areas discussed. S.P.

N67-17807# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electrical Engineering.
POLYNOMIAL CODES FOR POLYPHASE SIGNALS
Lars-Henning Zefferberg May 1966 30 p refs Supported by U.S. Tech. Advisory Comm. of the Joint Serv. Electron. Program and Swedish Tech. Res. Council
(Rept.-1-65) CFSTI: HC $3.00/MF $0.65

In order to investigate a new class of codes a system is considered where data are transmitted on a baseband channel of limited bandwidth and perturbed by white noise. Each signal is defined by 2r sample values derived from an r-dimensional phase vector and requires a fixed energy. Each coordinate of the phase vector has one of p equidistant values on the unit circle where p is a prime integer. The encoding is defined by means of the phase vector where the first k coordinates carry the information while the others are used to improve the detection capabilities. They are derived through polynomial multiplications in a field of p^k elements. The structure of these codes is analyzed with reference to an ideal matched filter detector and the error probability is evaluated. Numerical calculations are made for several combinations of p, k and r when p^k is less than 1000. Certain codes are shown to be quite efficient in producing a low error probability at a given information rate and signal to noise ratio on the channel. Author (ESRO)

N67-17813# European Space Vehicle Launcher Development Organization, Paris (France).
INTRODUCTION TO SYNTHESIS OF RADIO GUIDANCE AND TRACKING STATIONS
R. Cossert Sep. 1966 80 p refs
(ELDO-TM-F-17) CFSTI: HC $3.00/MF $0.65

In order to provide the non-specialist with an insight into the choice of the basic station parameters, a review of elementary theory on radio guidance and tracking stations is presented. The presentation is intended to be of direct interest to the ELDO Future Program Project Studies on radio guidance and tracking stations. It should be noted however, that none of the systems discussed should be considered as a definite proposal. They are all ad hoc examples that enable us to think in terms of concrete systems and are therefore useful as a reference or guide for developing a program of future work. Author (ESRO)

N67-17824*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SENSITIVE S-BAND NOISE RECEIVER DEVELOPED FOR THE MARINER MARS 1964 SPACECRAFT PROGRAM
Louis H. Keeler, Andrew J. Nalbandian, and Albert A. Olbeter 15 Nov. 1966 26 p refs
(Contract NAS7-100)
(NASA-CR-81637; JPL-TR-32-1029) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Noise receiver tests during *Mariner* spacecraft test operations are summarized. The noise receiver system performed reliably and accurately. No major compatibility problems were encountered. The system verified that undesirable noise levels or spectral components were not present in the critical frequency regions and provided standby support for crucial tests during Pasadena and Cape Kennedy spacecraft operations. Some system design improvements for future spacecraft operational support requirements are discussed. The receiver system noise-figure measurements and operation procedure employed and the system noise temperature analysis for space chamber tests and high bay tests (Pasadena operations), are documented. Author

N67-17840*# Space-General Corp., El Monte, Calif.
STUDY OF CONCEPTUAL DEEP SPACE MONITOR COMMUNICATIONS SYSTEMS USING A SINGLE EARTH SATELLITE. VOLUME II: INTERFACE RELATIONSHIPS, TRADEOFF ANALYSIS AND STUDY RESULTS Final Report
E. F. Lally Sep. 1966 89 p refs
(Contract NAS2-3179)
(NASA-CR-73035; SGC-920FR-1, Vol. II) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Reported are results of a study designed to determine the feasibility and capability of concepts for deep-space communications employing single earth satellites; to perform parametric analyses to indicate the more promising integrated system concepts; and to expose technical problem areas and indicate how such problem areas can influence the choice and performance of candidate systems. The study resulted in a parametric analysis of deep space monitor communication systems consisting of a single earth satellite and associated interplanetary spacecraft. The accomplishment of the study objectives required parametric analyses involving considerations of frequency, bandwidth, radiated power, data rate, antenna size, weight and volume, and orbit inclination and altitude. Evaluation of support requirements were also necessary as were antenna fabrication and deployment, equipment modules, attitude control, power sources, micrometeoroid dust and radiation shielding, launch vehicles and site selection, and logistics and resupply. Considerations were given to system integration and tradeoffs as required to monitor both manned and unmanned spacecraft for planetary missions. Author

N67-17848# Centro di Studio per la Fisica delle Microonde, Florence (Italy).
LOCAL IONOSPHERIC MEASUREMENTS. A PROBE WITH GRIDS FOR MEASUREMENTS OF ELECTRON DENSITY [MISURE LOCALI IONOSFERICHE. SONDA PER MISURE DI DENSITA E TEMPERATURA ELETTRONICA]
P. Bruscaglioni, V. Cappellini, P. F. Pellegrini, and G. Venture Mar. 1966 85 p refs In ITALIAN; ENGLISH summary
(CM-R27-10.1) CFSTI: HC $3.00/MF $0.65

An electrostatic probe with two grids to be placed on the nose of a rocket is described. The probe works in two different ways. In order to measure ionization density the second grid is at strong negative voltage, and a collector is reached by positive ions only. To measure electron temperature, the collector is at strong positive voltage. A Langmuir analysis of the electron current to the collector is made by means of a saw tooth voltage applied to the second grid. The first grid is grounded to the rocket. Laboratory tests on the prototype are reported. Author (ESRO)

N67-17846# Centro di Studio per la Fisica delle Microonde, Florence (Italy).
LOCAL IONOSPHERIC MEASUREMENTS. AN RF PROBE FOR ELECTRON DENSITY MEASUREMENTS [MISURE LOCALI IONOSFERICHE. SONDA A RADIOFREQUENZA PER MISURI DI DENSITA ELETTRONICA]
P. Bruscaglioni, V. Cappellini, P. F. Pellegrini, and G. Ventura Mar. 1966 74 p refs In ITALIAN; ENGLISH summary
(CM-R28-10.2) CFSTI: HC $3.00/MF $0.65

An rf probe is described. Its working principle is based on the fact that an electrically short antenna is practically a capacitor. A double oscillator constitutes the main part of the probe. One of them is connected to a dipole antenna placed on a rocket travelling in the ionosphere. The beat frequency from the two oscillators contains the information on the dielectric constant of the medium (i.d. in our case on the ionization density). The antenna, and the circuits of measurements and calibration are reported as well as laboratory tests. Author (ESRO)

N67-17848 Royal Radar Establishment, Malvern (England).
ACTIVE FILTERS USING SIMULATED INDUCTANCE
R. L. Ford and F. E. J. Girling Jan. 1966 27 p ref
(RRE-TN-717) CFSTI: $3.00

Active circuits for simulating inductance are described which can be used as direct replacements for the inductors in passive LCR filters. The method of realization is based on the analogy between the relationship $i = 1/L \int Vdt$ for an inductor and the transfer function $V_o/V_i = -1/pT$ for an electronic feedback integrator. The use of a constant current source is avoided and the three variations given may be built up from active circuits having other applications. Author (ESRO)

N67-17865# Royal Aircraft Establishment, Farnborough (England).
STUDY OF AN AERIAL FOR LOW ANGLE RECEPTION AT HF
R. H. McLaughlin Feb. 1966 81 p refs
(RAE-TR-66054; AD-483716) CFSTI: HC $3.00/MF $0.65

It has previously been shown theoretically that very low angles of fire down to 1° elevation were obtainable in the HF band with aerials placed on the seashore with the sea providing the conducting plane. An experiment was conducted to test this theory and to obtain an array of inverted Vee elements for use on other experiments, with a narrow beam and low angle of fire. Measurements on model and full size aerials, including single Vee elements of different constructions and arrays of four and eight elements were undertaken. For the full size measurements, an aircraft equipped with three transmitters provided a moving source of signals whose position could be accurately determined at any instant by the Decca Navigator System. Although the array was not entirely successful, it was shown that a small movement nearer to the sea should achieve the desired result. A comparison between the theoretical and practical polar diagrams was undertaken and these showed a close relationship. An attempt was also made to reduce the vertical beamwidth by connecting two Vee's in series. Author

N67-17897# Commissariat a l'Energie Atomique, Fontenay-aux-Roses(France). Centre d'Etude Nucleaires.
DESIGN OF A HIGH FREQUENCY ANALYZER [ETUDE ET REALISATION D'UN ANALYSEUR DE SIGNAUX A HAUTE FREQUENCE]
Jean Bourbigot Jan. 1966 54 p In FRENCH
(CEA-R-2942; EUR-2701-f)

A device was designed for the amplitude and frequency analysis of electric or electromagnetic signals in the frequency range of 0 to 55 MHz. The frequency spectrum of a preset bandwidth is displayed on the screen of an oscilloscope. Conceived to analyze the electromagnetic oscillations that can be generated in a plasma, its main characteristics are the following: extended bandwidth of analyzed frequencies, on both sides of the ion cyclotron frequency in a magnetic field up to 20 kGs; linear amplitude and frequency response; possibility of analyzing a narrow band; high sensitivity; and analysis repetition rate of 25 per second. Author (NSA)

N67-17909# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SHORTWAVE DIRECTIONAL ANTENNA FOR RANGES OF 5.5–18.5 MC
O. Shmidt 8 Dec. 1966 7 p Transl. into ENGLISH from Radio (Moscow), no. 5, 1965 p 63
(FTD-TT-66-536; TT-67-60195; AD-643821) CFSTI: HC $3.00/MF $0.65

The construction of a new 78-m high, 500-t tow-array antenna in Nauen near Berlin for Radio-DDR broadcasting is briefly reported. The main lobe direction is controllable in both vertical and horizontal planes; the two arrays from a 50 degree angle. It takes six minutes to set the antenna in any specified direction by automatic, programmed control. The antenna is supplied via a coaxial aluminum waveguide which has a pulsation of 1.1, an attenuation of 0.15 dB per 100m, and a frequency of 30 mc. Author (TAB)

N67-17952# Ohio Univ., Athens. Avionics Research Group.
VOR PROPAGATION AND STABILITY STUDY Final Report
Richard H. McFarland, James T. Gorman, and Ted A. Gutwein Nov. 1966 106 p refs
(Contract FA-65-WA-1299)
(EER-11-1; FAA-RD-66-92)

Results of a theoretical and experimental study on VOR radial stability are presented. Error introduced by propagation effects have been bracketed and found to be less than 0.2 degree. Principal contributions to error and instability in the presentation of VOR radial position have been identified as variations in frequency of the auxiliary power source at the transmitter station, the VOR receiver responding to changes in signal level, and ambient temperature and receiver noise. Identified also are the effects of signals reflecting from aircraft which produce impulse type deviations in the CDI, recordings. Results show line-of-sight stations to be less affected by reflections from aircraft than the diffraction site where the signal level is usually lower in magnitude. Statistical summaries are provided of the 12,312 hours of data collected using three line-of-sight monitor stations and one diffraction site ranging in distance from 150 feet to 42.2 miles. Author

N67-17979*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
MILLIMETER-WAVE RADIOMETRY FOR RADIO ASTRONOMY Final Report, 1 Aug. 1964–15 Sep. 1966

W. V. T. Rusch, S. D. Slobin, and C. T. Stelzried Dec. 1966 36 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951424)
(NASA-CR-81644; USCEE-183) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Instrumentation and antenna development, and solar and lunation observations are reported in a study of millimeter wave radiometry for radio astronomy. Emphasis is placed on a feedhorn redesign and the development of a nodding subdish beam switching system which included fabrication, testing, and a theoretical analysis of the electromagnetic aspects. Included are test results of mechanical construction and performance, and radio frequency performance. C.T.C.

N67-17982*# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
DEVELOPMENT OF AN OPTICAL SUPERHETERODYNE RECEIVER Interim Final Report No. 2, Mar. 1965–Oct. 1966
R. Lucy Oct. 1966 81 p refs
(Contract NAS8-11588)
(NASA-CR-81659) CFSTI: HC $3.00/MF $0.65 CSCL 09F

An optical superheterodyne receiver, which operates at 6328 Å, is mounted in a mobile van, and can coherently detect signals from a remote laser transmitter, was designed, constructed and tested. Communications experiments, designed to evaluate the optical superheterodyne receiver and to compare coherent and noncoherent optical detector techniques, were performed over a one kilometer path using a remote laser transmitter. The long and short term results obtained, plus results of frequency modulation experiments, provide information for comparing a noncoherent amplitude modulation system, a coherent amplitude modulated system, and a coherent frequency modulated system. The results show the superiority of noncoherent detection techniques when the system is not limited by background radiation noise. R.N.A.

N67-17989*# Michigan Univ., Ann Arbor. Radiation Lab.
ADMITTANCE OF A WEDGE EXCITED CO-AXIAL ANTENNA WITH A PLASMA SHEATH
Chi-fu Den (Ph.D. Thesis) Oct. 1966 151 p refs
(Grant NsG-472)
(NASA-CR-81660; TR-5825-9-T) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Cylinder with a wedge and a coaxial shell with an axial slot make up the antenna. A stationary expression for the admittance is obtained when the antenna is enclosed by a plasma sheath. The basis of the admittance calculation is the electric field of the wedge aperture derived from a solution of two coupled integral equations. The calculations are carried out for the parameter ranges. The radii of the cylinder and shell are, in wavelength, from $0.05/\pi$ to $2/\pi$ and from $0.055/\pi$ to $2.2/\pi$, respectively. The plasma sheath thickness is from 0 to $2.5/\pi$. The plasma frequency to signal frequency ratio, ω_p/ω, is from 0 to 5. Collision frequency to signal frequency ratio, ν/ω, is 0; 0.01; 0.1, and 0.5. The angular width of the wedge slot and the shell slot are the same and equal to 0.08 radians. The results indicate: For $\omega_p/\omega > 1$, conductance and susceptance depend weakly on the plasma sheath thickness. For $\omega_p/\omega > 1$ and $\nu/\omega = 0$, conductance decreases exponentially when either the sheath thickness or ω_p/ω increases. Susceptance depends primarily on ω_p/ω and inappreciably on the sheath thickness. An increase of ν/ω increases the conductance but modifies the susceptance only slightly. The coaxial slotted shell behaves as an ideal voltage transformer in the equivalent antenna circuit. Author

N67-17992*# Quantum Engineering, Inc., Pasadena, Calif.
PRELIMINARY EXAMINATION OF PROBLEMS IN COMMUNICATING WITH ANION-ROCKET-DRIVEN INTERPLANETARY SPACECRAFT BY MEANS OF 2.1- TO 2.3-GHz RADIO SIGNALS
George I. Cohn Oct. 1966 364 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-81651) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A study was made of possible spacecraft communications interference due to the ion engine exhaust beam, in particular signal attenuation, signal distortion, and radio noise generation. Results show that signal loss via attenuation in the ion exhaust beam is negligible for contemplated ion engines, provided that the signal frequency is above the plasma frequency. For a semihomogeneous ion exhaust beam model, the signal ray losses for normal incidence are several orders of magnitude above the electron collision losses in the parameter ranges of interest, but are small enough to be neglected. For nonnormal incidence, signal rays encounter a solid angle or area within the ion exhaust beam which completely blocks transmission. Signal reduction due to spreading of the signal beam which passes through the ion exhaust beam has a lower bound of a few decibels at the spacecraft's exit plane. Distortion is negligible with the signal frequency above the plasma resonant frequency for normal operation, and when the signal ray is perpendicular to and passes through the axis of symmetry of the ion exhaust beam. The bremmstrahlung noise power generated per unit length of the ion exhaust beam may be significant in the frequency band of interest. R.N.A.

N67-18025* Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
COMMAND AND COMMUNICATION SYSTEM TEST SET GROUND SUPPORT EQUIPMENT Final Report
11 Nov. 1966 66 p refs
(Contract NAS8-20546)
(NASA-CR-81609; Rept.-3172-1/9) CFSTI: HC $3.00 CSCL 09F

Details are given on the development of a test set designed to check out the command and communications transponder in four different modes of operation. Significant technical achievements are identified as the Manned Space Flight Network simulator; the rf leakage, isolation, and rf path accuracy; the ranging subsystem (delay measurement); ease of operation; long term stability; and suppression of radio frequency interference. Functionally, the test set transmits a precisely controlled S-band rf signal, with various subcarriers and modulation, to the transponder under test; receives the S-band rf signal reply from the transponder and demodulates the various subcarriers and modulation; and evaluates several transponder parameters. Data are also presented on tests to determine the signal to noise ratio of 70 kHz demodulator, command channel phase response, and transponder ranging delay. Although it was concluded that the test set met the specified objectives, several recommendations are proposed for improving its performance. M.G.J.

N67-18026* Motorola, Inc., Scottsdale, Ariz. Aerospace Center.
AROD TECHNICAL DESCRIPTION Special Technical Report
20 Jan. 1967 70 p
(Contract NAS8-11835)
(NASA-CR-81697; ACR-3065-9-1) CFSTI: HC $3.00 CSCL 09F

The advanced airborne range and orbit determination (AROD) system concept is examined, and details are given on the design, fabrication, assembly, and proposed test of the feasibility model. The AROD is defined as an S-band, cw radio ranging system for providing accurate information on the position and velocity of a moving vehicle. This information is derived from measurements of

slant range and radial velocity between the vehicle and three fixed transponder stations. It is pointed out that the AROD system is unique in that the measurement, data collection, and position determination are performed on-board the vehicle in near real time. Advanced techniques in modulation, coding, and microminiaturization, used in making the complex vehicle-borne equipment practical, are discussed. The test model hardware is described, and the essential elements of the AROD system as implemented for the feasibility model are shown in a block diagram. Analytical data are included on the error signals produced at the reference element during L-code and H-code acquisition. M.G.J.

N67-18038*# Brown Engineering Co., Inc., Huntsville, Ala.
AN/GMD RAWIN SET RECEIVER SYSTEM Final Report
Dec. 1966 37 p
(Contract NAS8-20587)
(NASA-CR-81528) CFSTI: HC $3.00/MF $0.65 CSCL 09F

In evaluating techniques for range improvement of the rawin system, several approaches which provide similar performance parameters are investigated from the standpoint of cost, reliability, size weight, and environmental aspects. The evaluation covers the receiver, single diode mixer, IF amplifier and demodulator, saturation and dynamic range, comparator, transmitter, 403 MHz transmitter antenna, and receiving antenna. Necessary modifications are recommended. Details are also given on the hardware design and development for the solid state receiver subsystem. Test data sheets are included for the solid state receiver subsystem. Test data sheets are included for the tunnel diode amplifier and the mixer preamplifier. M.G.J.

N67-18045*# New Mexico State Univ., University Park. Physical Science Lab.
NASA RADINT SYSTEM SITE MANUAL
W. L. Joosten, W. G. Gammill, and E. D. Lee Jun. 1966 87 p refs
(Contract NAS5-9125)
(NASA-CR-81707; PN00403) CFSTI: HC $3.00/MF $0.65 CSCL 13I

The RADINT (SSD) system is capable of making trajectory measurements with great precision. This precision of measurement depends to a very large degree upon the precision with which the RADINT site is initially established and upon the care with which the site measurements are maintained. The purpose of this report is to present all the errors and tolerances in condensed form to aid site engineers in deciding on the acceptability of the site parameters at new sites and in maintaining necessary accuracy at old sites. The basis for arriving at these tolerances is shown. Where the calculations and derivations have appeared previously, they have been abstracted. Author

N67-18075*# Physics Lab. RVO-TNO, The Hague (Netherlands).
SEQUENTIAL DETECTION [SEQUENTE DETECTIE]
G. A. van der Spek Sep. 1966 41 p Refs In DUTCH; ENGLISH summary
(PH.L-1966-16; TDCR-66629) CFSTI: HC $3.00/MF $0.65

After introducing detection theory as derived from the theory of testing statistical hypotheses, conventional detection, with a fixed observation interval, is confronted with sequential detection with an observation interval which depends on the progress of the test. The optimum sequential test is reviewed and compared with conventional detection for three detection examples: coherent detection of a known signal in white Gaussian noise, envelope detection of a sinewave in the same kind of noise, and detection of noise in noise. The application of sequential detection in radar and sonar is indicated. Author

N67-18086# Kansas State Univ., Manhattan. Dept. of Electrical Engineering
BACKSCATTER OF ELECTROMAGNETIC WAVES FROM A ROUGH LAYER
Vijay R. Kumar, S. H. Durrani, and W. W. Koepsel May 1966 103 p refs Prepared for Kans. Univ.
(Contract NSR-17-004-003)
(NASA-CR-81757; EE-TR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20N

A target consisting of a rough layer with the front surface smooth and the back surface statistically rough was chosen for this study. Theoretical expressions were derived for the mean value of the radar cross section of the rough layer. These expressions turn out to be complicated functions of the angles of incidence and scatter, frequency, mean depth of layer, dielectric and statistical properties of the rough layer, etc. Experimental work was conducted using the acoustic simulation technique. A plexiglas layer was carefully machined on one surface to obtain a statistical variation in the thickness with nearly Gaussian distribution and nearly Gaussian correlation function. The layer was placed in a water tank with water on one side and air on the other, and was struck by pressure waves from electro-acoustic transducers of different frequencies. The backscattered signal was recorded for eight frequencies, four angles of incidence, and two different configurations of the layer. The theoretical as well as experimental results indicate that the average radar cross section of a layered target decreases as the rough surface of layer becomes more rough, and as the angle of incidence becomes more oblique. Other implications of the theoretical expressions and the measured curves are also discussed. Author

N67-18102*# Martin Co., Denver, Colo. Aerospace Div.
ADDRESSABLE TIME DIVISION DATA SYSTEMS FLYABLE PROTOTYPE EQUIPMENT Final Report
R. Burtzlaff and J. Goodwin Nov. 1966 63 p refs
(Contract NAS8-20514)
(NASA-CR-81738) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Design, construction, and testing are described for prototype units of a multiplexer with ten separate address processors for use in flight equipment. All units were tested for proper operation under normal ground conditions; and a complete set of modules as in the measuring source (multiplexer) was subjected to thermal, humidity, vibration, and electromagnetic interference tests. While module operation was excellent, power supply presented some difficulties. The initial power supply was encapsulated with a high impedance short that could not be corrected; and a second power supply completed all of the tests, but a filter capacitor shorted at the end of the temperature cycling. Since no design fault could explain this failure, a third power supply was constructed that repeated the temperature cycle twice without failure. Addition of two small ceramic capacitors at the input to the power supply provided additional filtering. Performance of the measuring source exceeded specifications, and the distributed telemetry multiplexer concept with a single address and single data cable is considered feasible. M.W.R.

N67-18103* Michigan Univ., Ann Arbor. Dept. of Aeronautical and Astronautical Engineering.
THE USE OF STATISTICAL DEPENDENCE BETWEEN DATA SAMPLES IN BINARY PCM DEMODULATION
James Kinard Strozier (Ph.D. Thesis) Nov. 1966 38 p refs
(Grant NsG-2; ORA Proj. 02905)
(NASA-CR-81763) CFSTI: $3.00 CSCL 09D

The use of statistical dependence between pulse code modulation (PCM) data samples in several optimal and suboptimal demodulators is tested. Optimal demodulators investigated are those with minimum error probability, minimum mean absolute error, and minimum mean square error. Only single data sources are

included, but the extension to multiple data sources is considered obvious. Analog data sources come from a Gaussian random process with known autocorrelation; and this becomes important during computer simulation. Channel noise is considered additive only; independent of the transmitted signal; and bandlimited, white, and Gaussian. Demodulated signals are compared with the quantized data samples transmitted rather than the original analog data. Computer programs for the various demoulators are included. correlation coefficients are given for Butterworth data, and a generalization is made to arbitrary bit waveforms. M.W.R.

N67-18167 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE-ORBITS GROUP FROM MALTA, MAY 1966
1966 41 p *Its* Issue No. 20, Pt. 2
CFSTI: $3.00

Presented are the cinetheodolite satellite observation data received in Malta during May and July, 1966. Tables contain azimuth, elevation, and time values. G.G.

N67-18168 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA, JULY 1966
1966 38 p *Its* Issue No. 21, Pt. 1 For Abstract see N67-18167 07-07
CFSTI: $3.00

N67-18169 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA, JULY 1966
1966 52 p *Its* Issue No. 21, Pt. 2 For Abstract see N67-18167 07-07
CFSTI: $3.00

N67-18170 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA, JULY 1966
1966 30 p *Its* Issue No. 21, Pt. 3 For Abstract see N67-18167 07-07
CFSTI: $3.00

N67-18171 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA, JULY 1966
1966 30 p *Its* Issue No. 21, Pt. 4 For Abstract see N67-18167 07-07
CFSTI: $3.00

N67-18172 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA, JULY 1966
1966 35 p *Its* Issue No. 22, Pt. 1 For Abstract see N67-18167 07-07
CFSTI: $3.00

N67-18173 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA, JULY 1966
1966 33 p *Its* Issue No. 22, Pt. 3 For Abstract see N67-18167 07-07
CFSTI: $3.00

N67-18196*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENT OF ANTENNA IMPEDANCE IN THE IONOSPHERE. I: OBSERVING FREQUENCY BELOW THE ELECTRON GYRO FREQUENCY
R. G. Stone, R. R. Weber, and J. K. Alexander [1966] 25 p refs Submitted for Publication
(NASA-TM-X-57219) CFSTI: HC$3.00/MF$0.65 CSCL 20N

The problem of the behavior of an antenna in a magnetoionic medium is very briefly reviewed. Experimental measurements of both the resistive and reactive components of the impedance of a short dipole in the lower ionosphere are reported for the range of conditions corresponding to $0 < X < 3$ and $1 < Y < 1.5$. The antenna reactance is found to decrease with increasing $X = (\omega_p/\omega)^2$ whereas the resistive part of the antenna impedance is found to be many orders of magnitude greater than its free space value for $X \geq 1$. Only qualitative agreement is found between experiment and theory. The significance and possible interpretation of the large real component of impedance are discussed. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-16940# System Development Corp., Santa Monica, Calif.
SECURITY IN THE COMPUTER ENVIRONMENT
Robert L. Dennis 18 Aug. 1966 34 p
(Contract AF 19(628)-5166)
(SP-2440/000/01; AD-640648) CFSTI: HC$3.00/MF$0.65

The problems of safeguarding classified information in relation to computers and computer technology are considered. In the digest presented, attention is focused on ways of insuring the security of information in a time-shared environment, of information stored on and erased from magnetic storage, and of electronic radiation emanating from a computer processing classified information. The need for extended guidance and for updating the Security Manual was stressed in the panel discussions. M.G.J.

N67-16964# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.
EVOLUTION OF COMPUTER SYSTEMS TO PERFORM PARALLEL PROCESSING
Morris A. Knapp *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 26 p refs (See N67-16962 07-34)
CFSTI: HC$3.00/MF$0.65

The organizational design of the general parallel network iterative array computer capable of performing up to one hundred simultaneous calculations, whereby a general purpose computer was used as the central control unit for a ten by ten array of processing elements, is given in detail. These one hundred processing elements which make up the array are all identical, small, serial, one megacycle per bit computers without instruction decoding

capability. The logical and hardware design of the entire system and the software design are given. An assembler language was developed for the system and is described. A sample of the target assignment problem using the algorithm developed by James Munkres has been programmed for the iterative array computer system to illustrate how the parallel organization can be used in problem solutions. Author

N67-17016# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE GEOS MAGNETIC CORE MEMORY UNIT
George D. Wagner Jul. 1966 47 p refs
(Contract NOw-62-0604-c)
(TG-839; AD-642620) CFSTI: HC $3.00/MF $0.65

The GEOS Magnetic Memory Unit functions with the Memory Control Unit and the Optical Beacon System. The Memory Unit is a highly reliable, small size, low power spacecraft memory. The memory uses magnetic memory cores, and operates serially. It has a capacity of 1365 bits, and is organized into 65 - 21 bit words. The memory scans at a 22.750 bits/sec. rate, completing one scan per minute. Integrated circuits have been used for logic and timing where feasible. Magnetic core matrices have been used for memory addressing circuits. The complete memory occupies 70 cubic inches, weighs 950 grams and consumes less than 200 milliwatts. Author (TAB)

N67-17076# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DUAL ONE DIMENSIONAL ANALYSIS AND DISPLAY PROGRAM
D. N. Samsky Sep. 1966 38 p
(Contract AT(45-1)-1830)
(BNWL-298) CFSTI: HC $3.00/MF $0.65

A computer program (DODAD) was written for simultaneous analysis of two independent signals in two 1024 channel analyzers. The program was written for use with the combination of a PDP-8 and a modified ND-160F analog to digital converter. NSA

N67-17079# Oak Ridge National Lab., Tenn.
ACTIFK: A GENERAL ANALYSIS CODE FOR O5R
F. B. K. Kam and K. D. Franz Sep. 1966 142 p refs
(Contract W-7405-ENG-26)
(ORNL-3856) CFSTI: HC $3.00/MF $0.65

The ACTIFK O5R-analysis code was written to facilitate the analysis of the collision tapes generated by the O5R neutron transport code. The code was successfully applied to a wide range of problems and reduced considerably the time previously required to achieve an operational program. ACTIFK requires that subroutines be written before it can be used. However, this disadvantage is minor when the user considers the following advantages: any of the methods of analysis already written can be used; any nonelastic event can be treated; most of the bookkeeping tasks, such tape reading and writing, initialization of parameters, finding the proper cross sections, checking for any overlapping of data and programs, etc., have been built into the code; optional statistical analysis subroutines are included which are useful in determining the significance of the Monte Carlo results; and very little coding effort is required. Author (NSA)

N67-17101*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SPACEBORNE MULTIPROCESSING SEMINAR
31 Oct. 1966 87 p refs Seminar held Museum of Sci., Boston, 31 Oct. 1966
(NASA-TM-X-59362) CFSTI: HC $3.00/MF $0.65 CSCL 09B

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8. COMPUTER DESIGN ASSISTANCE FOR THE EVOLVING LARGE SCALE INTEGRATED CIRCUIT TECHNOLOGY J. S. Merritt (Honeywell, Inc.) p 69–76 (See N67-17109 07-08)
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10. ON-LINE SIMULATION IN THE OPS SYSTEM M. Greenberger and M. M. Jones (MIT) p 81–85 (See N67-17111 07-08)

N67-17102*# Autonetics, Anaheim, Calif.
MULTIPROCESSOR ORGANIZATION FOR MANNED MARS MISSION
A. Williman, L. Koczela, and G. Burnett *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 3–10 refs (See N67-17101 07-08) CFSTI: HC $3.00/MF $0.65

Three different approaches to computer organization for a long duration manned space mission are given. Flexibility in meeting computational requirements is an important factor in the computer system design. The organizations are currently being evaluated, and preliminary evaluations indicate that a multiprocessor or distributed logic approach offers the most potential for future space missions. Author

N67-17103*# Bellcomm, Inc., Washington, D. C.
FUNCTIONAL REQUIREMENTS OF SPACEBORNE COMPUTERS ON ADVANCED MANNED MISSIONS
E. L. Gruman and P. S. Schaenman *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 11–19 refs (See N67-17101 07-08) CFSTI: HC $3.00/MF $0.65 For abstract see N67-15882

N67-17104*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
DESIGN CRITERIA FOR A SPACECRAFT COMPUTER
Ramon L. Alonso, Albert L. Hopkins, Jr., and Herbert A. Thaler *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 21–28 (See N67-17101 07-08) CFSTI: HC $3.00/MF $0.65

An idealized collaborative multiprocessor structure in which a number of processing elements are tied together by means of a single multiplexed data bus is explored. At least one job assignment procedure is possible for which no one processor has to act

as master, and which can survive processor malfunctions or the deletion or addition of processors to the bus, thus accomplishing graceful degradation and reconfiguration of sorts. This single bus structure as used here implies things about compilers for it, and also certain bandwidth relationships between processors, bus and common memory. Rough estimates based on short extrapolations of circuit technology show that the structure is probably realistic.
Author

N67-17105*# Autonetics, Anaheim, Calif.
EXECUTIVE PROGRAM CONTROL FOR SPACEBORNE MULTIPROCESSORS
Robert A. Hokom *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 29–35 (See N67-17101 07-08) CFSTI: HC$3.00/MF$0.65

The necessity for executive program control, a description of executive functions, and executive software implementation are discussed. The frame of reference is a spaceborne computer for a manned Mars mission. The reasons for having executive program control include requirements for reconfiguration to handle failures, computational loading, and unanticipated processing as well as the general questions of efficiency and timing. The executive functions described are program scheduling, inter-program communication, reconfiguration control, request processing, input/output supervision, and computer self-test. The applications of these function for a multimodule computer which is representative of many multiprocessors, illustrates their characteristics. Differences in executive implementation for other configurations are briefly discussed.
Author

N67-17106*# Sperry Rand Corp., St. Paul, Minn. UNIVAC Defense Systems Div.
SELF-REPAIR: FAULT DETECTION AND AUTOMATIC RECONFIGURATION
Earl C. Joseph *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 39–49 refs (See N67-17101 07-08) CFSTI: HC$3.00/MF$0.65

The automation techniques for a self-repairable digital computer in spaceborne multiprocessor computer systems are discussed. The fault detection, isolation, and location techniques required to recognize a system failure, to make the necessary real time self-repair adjustments to the hardware configuration, and recovery from errors are described. Details are presented on the self-diagnostics, fault recovery, programmed self-repair, and spare replacement switching. It is considered that the multiprocessor organization will have a continuous capability and 100% systems availability, and that the entire task from fault detection to process restoration can be automated by replacement switching with present day state-of-the-art techniques.
N.E.N.

N67-17108*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEM ORGANIZATION OF THE JPL SELF-TESTING AND SELF-REPAIRING COMPUTER AND ITS EXTENSION TO A MULTIPROCESSOR CONFIGURATION
Algirdas Avizienis *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 59–66 refs (See N67-17101 07-08) CFSTI: HC$3.00/MF$0.65

The techniques for the application of protective redundancy in digital systems are reviewed and compared. The choice of a replacement system as protective redundancy for a spacecraft guidance and control computer is reached by consideration of its computing requirements. The system organization of an experimental replacement system is described, with emphasis on the method of concurrent fault diagnosis by means of arithmetical encoding. An extension of the system to a multiprocessor configuration is considered as a means to provide on-board data processing after arrival at a remote destination.
Author

N67-17109*# Honeywell, Inc., St. Petersburg, Fla. Aeronautical Div.
COMPUTER DESIGN ASSISTANCE FOR THE EVOLVING LARGE SCALE INTEGRATED CIRCUIT TECHNOLOGY
John S. Merritt *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 69–76 (See N67-17101 07-08) CFSTI: HC$3.00/MF$0.65

The design of a multiprocessor computer system will be developed with the aid of an existing computer. Programs are presented which all work on the same reel of magnetic tape. This tape contains files each of which specifies the design of a particular unit. Details are given on the operational steps in execution of selected program tools for a particular equipment design which fall into four general categories: formulation of logic, simulation of operation, placement of components, and preparation of wire-run lists.
Author

N67-17110*# Massachusetts Inst. of Tech., Cambridge.
ESSENTIAL FEATURES OF ON-LINE SYSTEMS
Harry D. Huskey *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 77–80 (See N67-17101 07-08) CFSTI: HC$3.00/MF$0.65

The advantages of on-line use of computers for continuous periods of time are discussed, and are compared with the batch system of time sharing. The desirable characteristics of an on-line system are identified as: (1) The terminal must be low cost, implying low data-rate equipment. (2) Low data-rate terminals imply substantial amounts of system storage per user. (3) The active files of active users must be in quickly accessible memory. One solution to this problem is outlined briefly. It is pointed out that the on-line system must cater to the neophyte or occasional user and also to the professional user. The importance of proper software systems is emphasized.
N.E.N.

N67-17111*# Massachusetts Inst. of Tech., Cambridge.
ON-LINE SIMULATION IN THE OPS SYSTEM
Martin Greenberger and Malcolm M. Jones *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 81–85 (See N67-17101 07-08) CFSTI: HC$3.00/MF$0.65

The OPS system, an interactive system designed for use in a time-sharing environment, includes an on-line simulation capability. A simulation activity is scheduled, cancelled, or rescheduled dynamically on the AGENDA, either at a specified time, or when a prescribed condition is met. The activity can be made to consume simulated time by means of an internal delay for a certain period, or a wait until give conditions are satisfied. The AGENDA is a time-ordered list of all conditionally and unconditionally scheduled activities. The user may inspect it at any point and modify or restructure it. He may base his strategy on data and partial results examined and analyzed with the help of the OPS system during interruption of the run. Extensive tracing facilities permit the user to follow the flow of control during a simulation to any level of detail.
Author

N67-17257# Potter Instrument Co., Inc., Great Neck, N. Y.
HIGH DENSITY DIGITAL RECORDING SYSTEM
J. T. Potter and P. C. Michel 17 Mar. 1966 13 p
(PB-169697) CFSTI: HC$3.00/MF$0.65

Various aspects of high density digital recording systems are considered, and an effective system for increasing digital information density is described. The recording system for digital use is compared with a system for audio use. Characteristics of self-clocking high density and externally clocked high density versions are presented. It is concluded that both versions of a high density system make good use of the magnetic surfaces and reproducing heads now available.
S.P.

N67-17262 Chicago Univ., Ill. Inst. for Computer Research.
DATA TRANSMISSION BETWEEN THE MANIAC III AND THE IBM 7040
R. M. Herwitt, J. Bounin, and C. K. Teng *In its* ICR Quart. Rept., No. 9 1 May 1966 3 p (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

The 7040 subcomputer provides a path for data and control information travelling from Maniac III to the IBM 7040 and back. The five stages in the transmission of data to or from the 7040 are reviewed. A direct data transmission path to the 7040 is an indirect path to the IBM 7094, since the 7040 coordinates the input and output activities of the 7094. Consequently, the subcomputer enables Maniac III programmers to use the computing and input-output facilities of the computation center without carrying decks of cards from one installation to the other. S.P.

N67-17263 Chicago Univ., Ill. Inst. for Computer Research.
THE MAN–MACHINE REPORT Progress Report, 1 Jan.–31 Mar. 1966
C. C. J. Roothaan *In its* ICR Quart. Rept., No. 9 1 May 1966 3 p (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65
(PR-5)

Coding of the system scheduler, programming specifications, modification of the system assembler, and coding of the job deck processing module for the 7040 control program are briefly reviewed. In addition, the problems encountered in adapting the program-switchable tape drive feature as an input/output transmission medium are examined. S.P.

N67-17377*# General Dynamics/Convair, Huntsville, Ala.
AUTOMATIC MALFUNCTION ANALYSIS BY DISCRETE NETWORK SIMULATION. APPENDIX C: PROGRAMMERS REFERENCE MANUAL AUTOMATIC MALFUNCTION ANALYSIS PROGRAMS
Oct. 1966 99 p
(Contract NAS8-20016)
(NASA-CR-81530; GDC-DDF66-007) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. AUTOMATIC MALFUNCTION ANALYSIS PROGRAM (#3998) 48 p
2. AUTOMATIC MALFUNCTION ANALYSIS EDITOR PROGRAM D. R. Diaddigo 48 p (See N67-17378 07-08)

N67-17378*# General Dynamics/Convair, Huntsville, Ala.
AUTOMATIC MALFUNCTION ANALYSIS EDITOR PROGRAM
D. R. Diaddigo *In its* Autom. Malfunction Analysis by Discrete Networks Simulation. Appendix C Oct. 1966 48 p (See N67-17377 07-08) CFSTI: HC $3.00/MF $0.65

The AMA-Editor Program produces the search tapes for the RCA 110 program from the automatic malfunction analysis results. It operates in three modes, with corresponding changes in tape requirements. The selection of the operating mode is controlled by the first data card. Presented are the main program driver outline, flow charts, data word configurations, and referencing mechanisms. Subroutines are also discussed with an explanation of their options, techniques, and interrelationship with other programs through labeled common. A.G.O.

N67-17466# Los Alamos Scientific Lab., N. Mex.
THE ADMINISTRATION OF SECONDARY STORAGE IN NUCLEAR CODES
William J. Worlton 17 Aug. 1966 51 p refs
(Contract W-7405-ENG-36)
(LA-3546-MS) CFSTI: HC $3.00/MF $0.65

The importance of secondary storage in nuclear codes is discussed, together with the components and organization of storage systems. A review and evaluation of secondary storage devices is presented. NSA

N67-17473# Sandia Corp., Albuquerque, N. Mex.
THE TTA GENERALIZED RIGID BODY TRAJECTORY PROGRAM FOR DIGITAL COMPUTER
J. A. F. Allensworth Aug. 1966 151 p refs Previously published as SC-DR-64-526
(Contract AT(29-1)-789)
(SC-DR-65-511; SC-DR-64-526) CFSTI: HC $3.00/MF $0.65

Much valuable information concerning the movement of bodies in space can be obtained by the computation of theoretical trajectories. The TTA program was designed, not only to meet the developing requirements for trajectories, but to reproduce data from the actual range environment and to place the program into the hands of the user. TTA permits requesting the trajectory by means of a flexible language which is similar to English. The language and data structure of TTA permits adaptation to a large number of objectives. Author (NSA)

N67-17476# Los Alamos Scientific Lab., N. Mex.
GAUSSIAN ITERATIVE LEAST SQUARES TECHNIQUES FOR MODERN COMPUTERS [TECNICAS ITERATIVAS DE GAUSS DE LOS MINIMOS CUADRADOS PARA COMPUTADORES MODERNOS]
C. G. Chezem and R. H. Moore 29 Dec. 1965 70 p refs In ENGLISH and SPANISH
(Contract W-7405-ENG-36)
(LA-3362-MS) CFSTI: HC $3.00/MF $0.65

The general problem of estimating the parameters of a function to be fitted to a set of experimental data points (curve fitting) by the method of least squares is reviewed. An iterative method of fitting functions in which the parameters appear non-linearly, first presented by Gauss in the early 1800's, is discussed in modern language compatible with any high-speed digital computing machine. Suggestions are offered to experimenters and computer programmers based on extensive experience concerning the formulation and operation of such iterative routines, intepretation of the precision indicators of the fit, convergence criteria and the prevention of non-convergent oscillations. Some applications of the venerable Gauss method taken from the fields of nuclear science and chemistry are discussed. Author

N67-17484# Atomics International, Canoga Park, Calif.
LEAST SQUARES DETERMINATION OF ISOTHERMAL RATE CONSTANTS FOR THE OXIDATION OF METALS
W. A. Young 14 Jun. 1966 104 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11966) CFSTI: HC $3.00/MF $0.65

A least squares computer program is described which permits the solution of the rate expression, $(\Delta m + c)_n = Kt$, for all combinations of the three parameters, C, n, and K where Δm is weight change per unit area, C is a corrective constant, K is the rate constant, and t is time. The program is written in FORTRAN IV for use with IBM 7090/7094 and Systems 360 equipment, and provides for graphic display of data points and the least squares curve by means of SC-4020 automatic display equipment. Author (NSA)

N67-17555# Bettis Atomic Power Lab., Pittsburgh, Pa.
SCAT-1: A PROGRAM TO COMPUTE $T^n_{LL'}$ MATRICES ON THE PHILCO-2000
E. M. Gelbard and G. J. Peters Jun. 1966 10 p
(Contract AT(11-1)-GEN-14)
(WAPD-TM-571) CFSTI: HC $3.00/MF $0.65

The computer program SCAT-1 is used to compute $T^n_{LL'}$ matrices on the Philco-2000. The program computes $T^n_{LL'}$ for $0 \leq L' \leq 10$, $0 \leq L \leq 3$, $0 \leq n \leq 3$. These T's are computed in double precision through the use of a set of recursion relations. NSA

N67-17666# Naval Research Lab., Washington, D. C.
SPAD FORMATTER. THE BUFFER INTERFACE BETWEEN THE SATELLITE PREDICTION COMPUTER AND THE DISPLAY
R. J. Orsino and J. R. Boller 11 Oct. 1966 34 p refs
(NRL-6431; AD-643561) CFSTI: HC $3.00/MF $0.65

The computer generates information for as many as 11 satellites each 1.1 seconds. The formatter accepts these computer output words as they are generated and, through appropriate gating and timing sequences, presents the data to the display at a rate of 30 frames per second. The formatter also contains a magnetic core memory device which permanently retains map grid symbol information and provides temporary storage for points representing a suborbital path. As an experimental device, the formatter was built in a three-bay rack cabinet with room provided for possible expansion or modification of the design. To facilitate calibration and maintenance, a rack-mounted four-channel cathode-ray oscilloscope can be connected to a circuit drawer and desired test points selected by means of rotary switches. Other circuit features permit maintenance personnel to rapidly check the performance of computer and formatter and isolate any malfunction. The formatter performed as desired. The report discusses in general the design problems common to computer driven displays and considers specifically problem's encountered in designing the SPAD formatter as well as the theory of operation of the overall equipment. Alternative approaches to the digital logic design problems are presented whenever possible, and the philosophy and reasons for the particular approaches chosen for SPAD are given. Author (TAB)

N67-17703# Mitre Corp., Bedford, Mass.
RECENT DEVELOPMENTS IN THE MITRE SYNTACTIC ANALYSIS PROCEDURE
D. E. Walker Bedford, Mass., AFSC Sep. 1966 47 p refs
(Contract AF 19(628)-5165)
(MTP-11; ESD-TR-66-306; AD-642330) CFSTI: HC $3.00/MF $0.65

The MITRE syntactic analysis procedure for transformational grammars has been used to process sentences on-line in a display-oriented mode as well as off-line. This report describes additions to the program structure and the grammar made since the last report and presents the results of experiments with the procedure. Author (TAB)

N67-17710# School of Aerospace Medicine, Brooks AFB, Tex.
MANIPULATING DATES AND TIME LAPSES IN A COMPUTERIZED RECORDS SYSTEM
Harry M. Hughes Sep. 1966 17 p
(SAM-TR-66-77; AD-641278) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A technique for handling dates within a computer as consecutive integers is defined and illustrated. Various possible applications are suggested, with an example demonstrating conversion in, conversion out, time between dates, number of weekdays between dates, and identification of a biweekly report date. Author (TAB)

N67-17749# Naval Missile Center, Point Mugu, Calif.
A REAL-TIME COMPUTING SYSTEM FOR REDUCING RADAR CROSS-SECTION DATA TO MEDIAN VALUES
D. Mensa and K. Doi 2 Nov. 1966 32 p
(NMC-TM-66-49; AD-643988) CFSTI: HC $3.00/MF $0.65

The report describes the development of a real-time computing system to reduce radar cross-section data to median values. The concept, mechanization, and performance of the system are described. Author (TAB)

N67-17928 European Atomic Energy Community, Ispra (Italy).
CIRCUITRY PROBLEMS IN NON-NUMERICAL APPLICATIONS OF THE IBM 047 TAPE-TO-CARD CONVERTER [SCHALTPROBLEME BEI NICHTNUMERISCHEN ANWENDUNGEN DES LOCHSTREIFEN-LOCHKARTEN UMWANDLERS IBM 047]
F. A. Behringer Apr. 1965 80 p refs In GERMAN; ENGLISH summary
(EUR-2237.d) CFSTI: $3.00

Specified problems concerning IBM-047 punched card tape conversion, and twenty basic programming circuits are described. The circuitry problem of transcribing Russian letters or German umlauts into letters which can be handled by the common data processing machines operating only with the Latin alphabet is discussed. A program indicates the manner the Flexowriter converts punched tapes containing capital and small letters into corresponding punched cards on the tape-to-card converter. Data is included on four programming circuits which enable the tape-controlled card-punch IBM-047 to translate Flexowriter tapes into FORTRAN cards, and technical details are given on two impulse-number stores with inquiry-station and cycle-reset facilities which can be plugged into the program plate of the mentioned converter. R.Li.

N67-17966*# North Carolina State Coll., Raleigh.
BIBLIOGRAPHY ON OPTICAL INFORMATION AND DATA PROCESSING
J. P. Moffatt, A. T. Shankle, and F. J. Tischer, comp. Nov. 1966 77 p refs
(Grant NGR-34-002-038)
(NASA-CR-81662; RR-3) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A review of the literature on optical information and data processing was prepared to assist those working in this field to locate quickly literature pertinent to a specialized subject. The whole subject area is divided into 22 subtopics in order to accomplish this purpose. Subtopic areas such as correlation analysis, diffraction, electromagnetics, holography, interferometry, matched filtering, pattern recognition, television, photography, and modulation are included. A.G.O.

N67-17978* Autonetics, Anaheim, Calif.
ANALOG TO DIGITAL CONVERTER Final Engineering Report
21 Dec. 1965 41 p Prepared for JPL
(Contracts NAS7-100; JPL-951077)
(NASA-CR-81643; C5-1398/34) CFSTI: HC $3.00 CSCL 09B

The development, fabrication, and testing of a microelectronic analog to digital converter are summarized. This device converts an analog voltage applied to the input terminal into a binary coded digital number of eight bits. It is fabricated using state-of-the-art devices and technologies associated with microelectronic systems. Areas covered include physical and electrical requirements, technical description, thin film microcircuit development, reliability, and problem areas. C.T.C.

N67-17993*# General Precision, Inc., Glendale, Calif. Librascope Group.
NON-DESTRUCTIVE READOUT DATA MEMORY UNIT, PHASE I Final Report
29 Dec. 1966 250 p refs Revision I
(Contracts NAS7-100; JPL-950986)
(NASA-CR-81650) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Results of Phase I of a program for the development of a small, low-power, nondestructive-readout data memory unit for space application are presented. The prototype and the ultimate flight memory systems will store 1024 words each of 20 binary digits using the advanced woven plated wire memory element and integrated circuits. The Phase I effort comprised the design, fabrication, test and evaluation of a breadboard system containing a memory stack fabricated to package design and construction standards essentially identical to those for the prototype to be fabricated in Phase II. The breadboard system stores 256 words of 16 binary digits each. Its purpose is twofold: to demonstrate circuit electrical performance and the environmental and electrical performance and characteristics of the encapsulated memory stack for application in the prototype memory system. In addition, the Phase I effort included a study and formulation of the packaging for the prototype system, and the design and fabrication of a nondeliverable memory exerciser, capable of interfacing with either the breadboard or prototype system at the prescribed signal levels.
Author

N67-18017*# Dunlap and Associates, Inc., Darien, Conn.
DATA CONDITIONING AND DISPLAY FOR APOLLO PRELAUNCH CHECKOUT. MULTI-PARAMETER MONITORING DISPLAY
Richard D. Pepler Dec. 1966 41 p refs *Its* Rept.-675-TM-12
(Contract NASw-1363)
(NASA-CR-81728; SSD-66-374) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Various possible formats were investigated for monitoring multiple parameters on graphic CRT displays. The bar and contour histograms, density bar graph, strip chart formats of raw data, and moving estimates of mean and of standard deviation of the data formats were studied. Their interpretabilities were evaluated using streams of computer simulated data with specified characteristics. The differences among the summed rank values given by six judges were found to statistically highly significant. It was determined that the strip chart format of a moving estimate of the mean data was the best, with the bar histogram and the strip chart format of the raw data next. For detecting a change from a single to a bimodal distribution, the strip chart format of the moving estimate of the mean and the bar histogram were again ranked first and second. The moving estimate of the mean was found to provide the earliest indication of a change to the mean of the data, and the histogram format to give more information about the distribution of the data samples.
N.E.N.

N67-18022*# Honeywell, Inc., St. Petersburg, Fla. Military Products Group.
DESIGN AND DEVELOP A MOS MAGNETIC MEMORY Final Report, 11 Mar.–11 Sep. 1966
F. H. Edelman and E. L. Daniel 15 Oct. 1966 97 p refs
(Contract NAS8-20594)
(NASA-CR-81700) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Interface problems between plated wire memories and metal oxide semiconductor (MOS) devices are examined, and solutions to these problems are investigated and evaluated. These areas are identified as package compatibility between the plated wire stack and the MOS devices; interconnection of the memory and the devices; interconnection of the various MOS functional blocks; total reduction of interfaces and interface connections; manufacturing compatibility of the plated wire and the devices; and power and speed requirements. Address selection methods using MOS transistors (MOST) were compared, and a detailed analysis of an all MOST differential amplifier was performed to determine its limitations as a memory sense amplifier. The plated wire manufacturing process is discussed, and the nonexistence of any manufacturing incompatibilities between MOS devices and plated wires is shown.
M.G.J.

N67-18040*# California Univ., San Deigo.
A COMPUTER ROUTINE FOR RELAY TRAPPED PROTON DISTRIBUTIONS
R. Walker Fillius 1 Sep. 1966 8 p refs
(Contract NASr-116; Grant NsG-538)
(NASA-CR-81686) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The Fortran routine Relay I is described as an aid to scientists who desire easy computerized access to the trapped proton distribution measurements. The discussion covers the data reduction procedure, the coverage provided by the decks, the computation method, the call parameters, subroutines, timing, diagnostic printing, and tape assignments. A tabular summary is included on the Relay I orbit and instrumentation.
M.G.J.

N67-18052* Kansas Univ., Lawrence. Engineering Science Div.
AUTOMATIC PROCESSING OF MULTI-SPECTRAL IMAGES
George W. Dalke [1966] 59 p refs
(Grant NSR-17-004-003)
(NASA-CR-81735; CRES-61-16) CFSTI: $3.00 CSCL 09B

Three spectra-zonal images are used for evaluating an automatic mapping system. Each point on the images is assumed to fall within one of eight categories and statistical decision theory with a Baye's strategy is used to automatically classify the points into these categories. It was found that the probability of correct classification is relatively insensitive to the number of detectable gray levels in the original images; that most classification errors occurred on the spatial boundaries of categories; that the use of multiple images increased the number of detectable categories and reduced the effect of insufficient statistical information. A real time processor with a color coded output for the categories is described and, based on the results of the problem investigated, is recommended for construction.
Author

N67-18061# Arizona Univ., Tucson. Dept. of Electrical Engineering.
HIGH-SPEED MONTE CARLO TECHNIQUE FOR HYBRID-COMPUTER SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS
Howard Handler (Ph.D. Thesis) 1967 188 p refs

The analog-hybrid computer Monte Carlo technique for solving elliptic and parabolic partial differential equations has been implemented on a new hybrid computer capable of taking statistics over 1,000 two- or three-dimensional random walks each second. This exceptional computing speed and flexible digital control permit direct plotting of partial differential equation solutions; of perhaps even greater interest is the incorporation of such Monte Carlo routines in real-time analog computer setups in process control applications. In this connection the Monte Carlo method has been extended to a wider class of boundary conditions especially applicable to heat conduction/diffusion problems.
Author

N67-18088* Maryland Univ., College Park. Computer Science Center.
SYMBOLIC DESIGN OF THE BI-TRAN SIX COMPUTER

Abe Franck (FABRI-TEK Inc.) and Yaohan Chu Nov. 1966 51 p refs
(Grant NsG-398)
(NASA-CR-81745; TR-66-36) CFSTI: $3.00 CSCL 09B

A computer design language has been proposed with an aim to provide a digital computer designer a means to describe his logic model precisely and concisely. As a test of the language, the design of a commercially available digital computer, Bi-Tran Six, is symbolically described by using the proposed computer design language. This paper presents this design. Author

N67-18112# Joint Publications Research Service, Washington, D. C.
NEW ELECTRONIC COMPUTERS DEVELOPED
V. L. Arlazarov, A. S. Kronrod, and V. A. Kronrod 9 Jan. 1967 6 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), no. 2, Nov. 1966 p 299-301
(JPRS-39450; TT-67-30100)

Mention is made of the discrepancy between memory access time and time of operations in an electronic computer, as well as segregation and orderedness of memory. These brief notes deal with various types of addressing equipment and the choice of the address variant; and contain some miscellaneous remarks on addresses for commands, readdressing, and other tasks related to computer operation. M.W.R.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-16772*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Quality Control Dept.
HIGH RELIABILITY SCREENING OF SEMICONDUCTOR AND INTEGRATED CIRCUIT DEVICES Final Report
J. Lombardi, L. McDonough, and H. Padden Sep. 1966 158 p refs
(Contract NAS5-9639)
(NASA-CR-81319; QCM-51) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The program objectives were to investigate methods and techniques for high-reliability screening of semiconductor and integrated circuit devices to pinpoint the origin of potential failure mechanisms. Information thus gained was then used to determine the most effective techniques to screen those devices susceptible to failure. In the course of this program, an integrated screening-acceptance test specification was developed for semiconductor and integrated circuit devices to insure high-reliability requirements. Included are the general specification for digital integrated circuits which can be reproduced as is, and a description of the development of the specification and the results of all tests performed during this program. Author

N67-16859# Bulova Watch Co., Woodside, N. Y. Electronics Div.
PRODUCTION ENGINEERING MEASURE FOR TYPE CR-(XM-60)/U CRYSTAL UNITS Quarterly Report, Apr.-Jun. 1966
K. Dance Jun. 1966 16 p
(Contract DA-36-039-AMC-036213(E))
(QR-8; AD-642425) CFSTI: HC $3.00/MF $0.65

Resistance welding as a means of lead attaching is not recommended for center mounted crystal units since pull test values are much too low. The method does not show any merit which would warrant further investigations at this time. Ultrasonic fully investigated. Thermo-compression bonding and resistance welding was investigated to the point where they were shown to be not suitable methods of attaching center leads to low frequency crystal units. In general their pull test values are too low. Vacuum final plating can be done successfully on low frequency crystal units provided extreme accuracy is taken in the lapping and etching of the crystal loaves to frequency. Author (TAB)

N67-16884# Varian Associates, Beverly, Mass. Bomac Div.
PRODUCTION ENGINEERING MEASURE FOR LOW FIELD MAGNETRON BL-234C Quarterly Progress Report, 28 Apr.-28 Jul. 1966
Arnold M. Eklund 28 Jul. 1966 31 p refs
(Contract DA-36-039-AMC-06162(E))
(AD-641409; QPR-5) CFSTI: HC $3.00/MF $0.65

Life test of tube 11S has continued to 380 hours with RF operating characteristics still within specifications. Some missing pulses are discernible, but the percentage has not increased above that which was present after 130 operating hours. Peak RF power, heater power, pulse voltage, and current have also remained essentially unchanged. Tests were conducted to determine the presence, if any, of end-hat emission. Conclusions were established in the last quarterly report that end of life of tube number 121 was reached after 120 operating hours due possibly to end-hat emission, as evidenced by higher DC emission than theoretical perveance predicts. Further tests on this tube were terminated because of a previously scheduled dissection of the tube at Harry Diamond Laboratories. Tests of DC emission on several other tubes with life histories varying from 5 to 100 hours did not, however, reveal the same condition as tube number 121. Measurements were then taken of peak pulse voltage versus average anode current to observe voltage cut-off characteristics as an indicator of end-hat emission. Data taken on fresh tubes as compared with tubes that showed deteriorated performance did not establish evidence of any end-hat emission. In accordance with a request from Harry Diamond Laboratories, tube 3S, which successfully passed the shock test requirements of the BL-234C specification, was submitted to the same test with heater operating. No heater shorts or open resulted, and the tube continued to operate after completion of the test. TAB

N67-16974# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
SOLID STATE DISPLAY TECHNIQUES
Carlton J. Peterson *in* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 33 p refs (See N67-16962 07-34)
CFSTI: HC $3.00/MF $0.65

The capabilities of increased electroluminescent (EL) phosphor maintenance, new high contrast filter techniques, and mass produced control circuitry arrays in advanced display techniques, are discussed. Display requirements are determined by the pilot's basic range of perceptual sensitivities and by operational needs. Efforts were directed towards both of these areas to achieve a practical solid state display capability. The most important results of such efforts was a breakthrough in display filtering techniques which has permitted the fabrication of displays reflecting 2% of all incident light and transmitting 35% of all emitted light. Combining this capability with that of improved high intensity zinc sulfo-selenide EL phosphors, it has been possible to fabricate and flight test solid state displays that can be clearly seen under bright ambient conditions. Author

N67-17092# Martin Co., Baltimore, Md.
RADIATION EFFECTS ON INSULATED GATE FIELD EFFECT (MOS) INTEGRATED CIRCUITS Quarterly Report, 1 Apr.–30 Jun. 1966
David M. Long Oct. 1966 90 p refs
(Contract DA-28-043-AMC-01520(E))
(MND-3264-4; ECOM-01520-4; QR-4; Rept.-4; AD-641164)
CFSTI: HC $3.00/MF $0.65

The report covers the fourth quarter's effort of a program to determine the mechanism and extent of the transient and permanent effects of nuclear radiation on insulated gate field effect (MOS) integrated circuits. The report discusses the results of the past year's investigation of transient response phenomena in custom-built and commercial MOS transistors and commercial MOS integrated circuits. The primary conclusions from the study are indicated below. The transient gate current produced in MOS transistors by a pulse of ionizing radiation is composed of two major components: (1) current leakage from the gate lead to the package through the ionized encapsulated gas, and (2) photovoltaic displacement current resulting from the motion of induced carriers in the transverse electric field beneath the gate oxide. Both mechanisms produce larger response for n-depletion transistors than for p-enhancement transistors. Mechanisms of generally lesser importance are: photocurrents of protective gate diodes, gate-drain interaction leakage currents, and variations in gate current due to irradiation history. Charge scattering from the device leads is small, and ionization induced leakage through the gate oxide is negligible.
Author (TAB)

N67-17159# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aeropropulsion Lab.
ASPECTS OF USING INFRARED FOR ELECTRONIC EQUIPMENT DIAGNOSIS
Ruth A. Herman 31 Oct. 1966 28 p refs Presented at the 26th Natl. Conv. of the Soc. for Nondestructive Testing, Chicago, 31 Oct.–4 Nov. 1966
(AFAPL-CONF-67-7; AD-642428) CFSTI: HC $3.00/MF $0.65

The validity of infrared radiation as a checkout parameter for the diagnosis of electronic equipment is verified by laboratory research. Other advanced checkout techniques are reviewed and compared with that of infrared; the limitations of all the techniques are described. A discussion follows on the implementation of the infrared-radiation technique.
Author (TAB)

N67-17183 Naval Avionics Facility, Indianapolis, Ind.
EVALUATION OF THIN-FILM RESISTORS AND CROSSOVERS Final Report
John Paulus, comp. 15 Oct. 1966 103 p refs
(NAFI-TR-835; AD-640933) CFSTI: HC $3.00/MF $0.65

CONTENTS:
1. TEMPERATURE COEFFICIENT p 7–20 refs
2. STRESSED DISSIPATION p 21–24 ref
3. HUMIDITY STRESS p 25–34 refs
4. ACCELERATED LIFE p 35–43 refs
5. SHORT-TIME OVERLOAD p 58–59 refs
6. RESISTOR LOAD LIFE p 61–67 refs
7. CURRENT NOISE p 68–69 refs
8. CROSSOVER-HUMIDITY p 71–75 refs

APPENDIX
9. EXCERPTS OF STATISTICAL ANALYSIS 14 p (See N67-17184 07-09)

N67-17184 Naval Avionics Facility, Indianapolis, Ind.
EXCERPTS OF STATISTICAL ANALYSIS APPENDIX A Final Report
In its Evaluation of Thin-film Resistors and Crossovers 15 Oct. 1966 14 p (See N67-17183 07-09) CFSTI: HC $3.00/MF $0.65

Defined and discussed is the concept of significance level in the statistical analysis of thin film circuit production aspects. Evaluated are a batch process, and a continuous in-line process for their better percentage yield of acceptable circuits. The significance level is the probability of rejecting the null hypothesis when it is true.
G.G.

N67-17196# General Electric Co., Lynchburg, Va. Communication Products Dept.
MICROMINIATURE CRYSTAL UNIT TYPE CR-(XM-47)/U PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 27 Feb.–27 May 1966
R. L. Hatcher and R. D. Laney 27 May 1966 23 p
(Contract DA-36-039-AMC-06166(E))
(QPR-4; AD-641461) CFSTI: HC $3.00/MF $0.65

Progress report on a program to establish production techniques and demonstrate the capability of a pilot facility to manufacture reliable Microminiature Crystal Units Type CR-(XM-47)/U at a specified rate of 20 units per eight (8) hour shift. The solution to the aging problem was demonstrated with the submission of an additional engineering sample. The electron beam welder demonstrated production capability. The quality plan was submitted to the customer.
TAB

N67-17233# Army Electronics Labs., Fort Monmouth, N. J.
THE EFFECTS OF NOISE IN OSCILLATORS
Erich Hafner Feb. 1966 26 p refs Repr. from Proc. Inst. Elec. Electron. Engr., v. 54, no. 2, Feb. 1966 p 179–198
(ECOM-2772; AD-643319) CFSTI: HC $3.00/MF $0.65

An explicit expression for the output signal from an oscillator with several noise sources in the circuit is derived. This formula describes qualitatively and quantitatively the manner in which thermal and shot noise act to corrupt the performance of an ideal oscillator. The statistical properties of the signal are then evaluated, as it emerges from the oscillator stage, after passage through an output filter and after being operated on by an ideal n-times multiplier. Expressions are derived for the short term frequency stability, the power spectral density, and the power spectrum of the signal, as well as for the spectral density of the signal phase. The key to the results reported is an apparently novel perturbation technique which does not require smoothing of the instantaneous nonlinearity in the basic differential equation. Discussion of the solutions shows that the instantaneous nonlinearities cause the device to act simultaneously like a linear AGC oscillator and like a high Q passive tuned circuit, with each aspect accorded one half the total noise excitation. Possible implications of this effect for other types of transient conditions in oscillators are indicated briefly.
Author (TAB)

N67-17245# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
STUDY OF RECEIVER MIXER CHARACTERISTICS Final Technical Report, 1 Jun. 1965–1 Aug. 1966
Ernest E. Donaldson, Jr. and Richard W. Moss Sep. 1966 75 p refs
(Contract DA-28-043-AMC-01426(E))
(A-868-F; ECOM-01426-F; AD-640239) CFSTI: HC $3.00/MF $0.65

The report summarizes a thirteen month program concerned with the investigation of spurious product formations in conventional mixer circuits, and with the development of techniques whereby the levels of such formations could be predicted from limited measurements of mixer parameters. The interference characteristics

of diode, pentode, triode, and transistor mixer types were investigated for numerous ordered arrangements of mixer dc parameters, circuit configurations, and signal injection levels. The results have demonstrated that changes in the mode of signal and/or local oscillator injection, local oscillator level, mixer load conditions, or mixer dc voltages produce changes in response levels which are apparently unpredictable, and that attempts to develop prediction models based on discrete mixer parameters may be impractical. Tests were conducted on a diode mixer which verify that multiple mix products can occur due to signal and/or local oscillator harmonic injection, and that the levels of such products are dependent upon the phase orientation of the injected signals. Tests were also conducted which show the effects of mixer bias voltage on response phase position. A spurious response prediction technique for diode mixers previously developed at Georgia Tech was investigated to determine if modifications and improvements could be made to reduce prediction errors, and if this technique could be successfully applied to other mixer types. Maximum-upper-bound prediction methods which might give worst-case approximations of spurious response levels were also investigated. Prediction results are presented which were derived from the actual prediction of numerous data sets on diode, pentode, triode, and transistor mixers. Author (TAB)

N67-17251# Radio Corp. of America, Somerville, N. J.
HIGH PERFORMANCE THIN FILMS FOR MICROCIRCUITS Quarterly Progress Report, 1 Mar.–31 May 1966
Franz Huber and Walter Witt Sep. 1966 19 p refs
(Contract DA-28-043-AMC-01230(E))
(CR-66-565-31; QPR-5; ECOM-01230-5; Rept.-5; AD-640002) CFSTI: HC $3.00/MF $0.65

Insulating layers of hafnium dioxide were deposited onto p-type silicon wafers. N(+) regions were diffused into the silicon wafer to act as bottom electrodes of capacitors or as source and drain electrodes of mos field-effect devices. These fets, containing anodically-formed oxide layers as channel insulators (amos), exhibited good transfer characteristics. The results of experiments proved that siliconic technology can successfully be combined with thin-film hafnium technology, whereby only a limited number of processing steps are required to produce the necessary electrod inside the silicon wafer. The remaining parts of the active devices and all the passive components can be fabricated by the thin-film hafnium technology on the surface of the silicon substrate. Investigations of the leakage current of the anodic oxide films showed that the insulation resistance of thin-film Hf–HfO_2 capacitors was similar to that of other thin-film valve metal oxide capacitors in anodic direction, and superior in the cathodic direction. Author (TAB)

N67-17368 National Bureau of Standards, Boulder, Colo.
PRECISION CONNECTORS
In its Conf. on Precision Electromagnetic Meas. 1966 p 82-92
(See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

Symposium presentations in the field of precision connector applications are reported. Research developments are summarized for topics such as: (1) application of precision connectors to high frequency measurements, (2) techniques related to the measurement of small reflections in precision coaxial transmission lines, (3) 7mm precision connector PRECIFIX characteristics and applications, (4) performance, reliability, and utilization of the 7mm precision connector, and (5) importance of precision coaxial connectors in lumped parameter immittance measurements. A.G.O.

N67-17380# National Inst. for Research in Nuclear Science, Harwell (England). Nimrod Machine Physics Group.
SUPPORT INSULATORS FOR HIGH VOLTAGE APPARATUS IN VACUUM
K. D. Srivastava Jun. 1966 10 p refs
(RHEL-R-124) HMSO: 3s

The performance of glass and ceramic insulators for high voltage apparatus in vacuum is described. The insulators have been tested up to 430 Kv. The work described is a part of the development program for the electrostatic inflector used on Nimrod, the 7 BeV proton synchrotron. Author (NSA)

N67-17645# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR SILICON NPN SWITCHING TRANSISTORS Quarterly Progress Report, 25 Nov. 1965–25 Feb. 1966
Mark Siegel and Jack Fresse 25 Feb. 1966 17 p
(Contract DA-36-039-AMC-06164(E))
(T-21; QPR-3; AD-640484) CFSTI: HC $3.00/MF $0.65

Areas of progress during the quarter were as follows: (1) Evaluation of decreased substrate resistivity initiated. (2) Evaluation of increased breakdown voltage range initiated. (3) Tests of increased diffusion source time completed. (4) Evaluation probe measurements reviewed and standardized. (5) New emulsion developer installed. (6) Evaluation of photoresist coating thickness versus spin velocity completed. (7) Refined oxide etching techniques. (8) Preliminary evaluation of centrifuged KMER completed. (9) Investigation of metallization thicknesses versus pattern definition initiated. (10) Evaluation of experimental header capacitances completed. (11) All testing completed on Engineering Sample No. 1 units. (12) Engineering Sample No. 2 units delivered to the customer. Author (TAB)

N67-17648# TRW Semiconductors, Inc., Lawndale, Calif. Advanced Communications Dept.
TRANSISTOR, VHF, SILICON, POWER TYPE EL-2N (X-9) 5W 500 MC PEM Quarterly Report, 1 Feb.–30 Apr. 1966
R. Clarke, J. Crishal, J. Rica, C. Thompson, W. Weisenberger et al 30 Apr. 1966 52 p refs
(Contract DA-36-039-AMC-06163(E))
(QR-4; AD-642134) CFSTI: HC $3.00/MF $0.65

Processing of lots to determine the optimum diffusion depth was completed. Sputtered metallizing was accomplished. Continued package evaluation was undertaken and the results lead to a decision on the most suitable package. Author (TAB)

N67-17656# Lear Siegler, Inc., Grand Rapids, Mich.
SOLID STATE DISPLAY DEVICES Final Report, May 1963–Jun. 1966
Glenn L. VanWinkle and Mark A. DeBono Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1966 77 p
(Contract AF 33(657)-11554)
(GRR-65-1063; AFFDL-TR-66-81; AD-643525) CFSTI: HC $3.00/MF $0.65

The result of this program was the development of a solid-state display device utilizing binary input information. An extension of previous contract work, the program produced the application of thin film photoconductive elements, with as many as 128 individual switching elements on a single substrate. The photoconductor switches are driven with electroluminescent lamps. The readout is made up of five columns of segmented electroluminescent lamps with a resolution of 32 lines per inch. Four of the columns are of the thermometer type while the fifth is a single line which moves as a time reference. Author (TAB)

N67-17657# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
SOLID STATE DISPLAY TECHNIQUES Final Report, 1 Jul. 1965–30 Jun. 1966

Carlton J. Peterson Oct. 1966 40 p refs
(AFFDL-TR-66-123; AD-643530) CFSTI: HC $3.00/MF $0.65

The capabilities of increased electroluminescent (EL) phosphor maintenance, new high contrast filter techniques, and mass produced control circuitry arrays have greatly motivated Air Force interest in advanced display techniques. Due to the extremely short persistence of EL emission, the only realistic way of generating a useful level of display intensity for cockpit applications has been to drive the EL phosphor continuously. This requires the combination of EL phosphor layers with mass produced control circuitry. Such circuitry must accept and store high speed input signals, and switch, apply or restrict EL drive signals so that legible presentations can appear on the face of the display. Display requirements are first determined by the pilots basic range of perceptual sensitivities and second by operational needs. Considerable effort has been directed towards both of these areas to achieve a practical solid state display capability. Author (TAB)

N67-17671# Naval Weapons Lab., Dahlgren, Va.
FERRITES AS DISSIPATIVE RF ATTENUATORS
Joseph H. Francis Sep. 1966 36 p refs
(W-11/66; AD-640824) CFSTI: HC $3.00/MF $0.65

Principal-wave transmission line theory is used to investigate the feasibility of utilizing ferrites as dissipative radio frequency attenuators to reduce hazards of electromagnetic radiation to ordnance (HERO). The general characteristics of ferrites and their effect on the performance of a ferrite power attenuator are discussed. Two experimental ferrite-filled transmission-line filters are described; neither device provides the desired power attenuation over the 100 kilocycle per second to one megacycle per second frequency range. A description of two experimental ferrite attenuators which utilize the increased rf resistance of a wire-wound ferrite toroid is given; both devices provide satisfactory power attenuator constructed of miniature solid-tantalum electrolytic capacitors and wire-wound ferrite toroids; the power attenuation of this device exceeds the attenuation objective of 40 db at 100 kilocycles per second and 60 db at one megacycle per second. Although a miniature all-ferrite dissipative filter with the required attenuation can be constructed, a filter composed of solid-tantalum feed-through capacitors and either ferrites or magnetic conductors is considered to be superior. Author (TAB)

N67-17683# Sandia Corp., Albuquerque, N. Mex.
ANOMALOUS PHOTOCURRENT GENERATION IN TRANSISTOR STRUCTURES
D. H. Habing and J. L. Wirth Jul. 1966 25 p refs Presented at the Ann. Conf. of the IEEE, Palo Alto, Calif. Revised Supersedes SC-DC-66-1415
(Contract AT(29-1)-789)
(SC-DC-66-1821; CONF-660705-2; SC-DC-66-1415)

It was previously reported that, at relatively modest dose-rates ($\approx 10^9$ R/sec), certain transistor types exhibit an anomalous primary photocurrent response which results in serious departures from the commonly assumed linear dose-rate dependence. Additional experimental evidence concerning the anomalous photocurrent problem and a model which explains the observed data in terms of carrier generation and transport processes within the device are presented. The analysis and supporting experimental evidence shows that the observed phenomenon is the result of base-emitter junction breakdown. This breakdown is induced by transverse photocurrent flow in the active base region and causes the device to assume a common emitter configuration wherein the primary photocurrent is amplified by the device gain. Author (NSA)

N67-17725# Atomics International, Canoga Park, Calif.
ENERGY DEPENDENCE OF NEUTRON AND GAMMA RADIATION DAMAGE IN SILICON
M. N. Robinson, N. F. Davies, and S. G. Kimble 25 May 1966 54 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11887) CFSTI: HC $3.00/MF $0.65

Silicon transistors were irradiated in fission and water-moderated fission neutron spectra, and in several different gamma spectra. Predictions of displacement damage from a point defect model are compared with damage constants from experimental measurements of the common-emitter current gain. Significant agreement is demonstrated between a spectrum normalization scheme, based upon this damage model, and the experimental results. Base current measurements also confirm an analytical neutron–gamma damage equivalence. It is concluded that test irradiations of silicon devices in water-moderated fission neutron and gamma spectra may be directly applied to SNAP payload evaluations. Author (NSA)

N67-17743# Northrop Corp., Newbury Park, Calif. Applied Research Dept.
STUDY FOR GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION Quarterly Progress Report, 15 Jun.–14 Sep. 1966
James P. Raymond and Robert E. Johnson Dec. 1966 101 p refs
(Contract DA-28-043-AMC-00423(E))
(QPR-6; Rept.-6; ARD-66-62R; ECOM-00423-6; AD-643652) CFSTI: HC $3.00/MF $0.65

The saturation-inclusive bipolar transistor representation has been refined and written into a computer code to allow detailed comparison of analytical and experimental results. Electrical and radiation-induced saturated switching responses have been calculated from electrical parameter measurements. The agreement between calculated and experimental results is good. The lumped-model analysis of the monolithic circuit elements has been extended to the detailed qualitative characteristics of junction-isolated and dielectrically-isolated resistor and transistor elements. Comparison is made between the results of the lumped-model analysis and known solutions of the differential equation representation of the devices. Author (TAB)

N67-17764*# Stanford Univ., Calif. Electron Devices Lab.
THE OPPOSITE-STREAM PLASMA DIODE
Peter Burger Apr. 1964 136 p refs
(Grant NsG-299-63; Contract AF 19(604)-5480)
(NASA-CR-58200; SEL-64-012; TR-02541) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Consideration is given to the possible dc states of a one-dimensional plasma diode, which consists of opposing thermionic ion and electron emitters in parallel-plane geometry. The emitters can have different temperatures, and the assumptions of nonreflecting boundaries and complete lack of collisions are made. Electrons and ions are assumed to be generated with half-Maxwellian velocity distributions corresponding to their respective temperatures. For the case of nonnegative potential of the ion emitter with respect to the electron emitter all possible dc states are found. The stability of the dc states is examined by simulating the motions of the electrons and ions on a computer. An experimental model of the opposite-stream diode is constructed with a solid-state, thermionic lithium-ion emitter and a barium-oxide-coated electron emitter. S.P.

N67-17810# Gt. Brit. Ministry of Aviation, London.
NON-DETERIORATION OF H.R.C. FUSE-LINKS ON AIRCRAFT
G. W. Hunton Jun. 1966 15 p
(S&T-MEMO-5/66) CFSTI: HC $3.00/MF $0.65

Examination over a five-year period of H.R.C. fuse-links alleged to be defective in service revealed no signs of deterioration or aging of component parts. Examination of a large number of H.R.C. fuse-links in service for over ten years, some from Valiant aircraft with between 2,100 and 2,600 flying hours, and some from a Brittania aircraft with over 14,5000 flying hours, showed that the fuse-links had not deteriorated and their performance characteristics had not altered. Author (ESRO)

N67-17905# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHASE DETECTOR WITH PULSE-WIDTH MODULATION

V. Yu. Vorobkevich, I. S. Danilyuk, and L. A. Sinitskiy 30 Sep. 1966 16 p Transl. into ENGLISH from Pribory Prom. Kontrol. i Sredstva Avtomat., Dokl. i Soobshch. (USSR), 1963 p 330–342 (FTD-TT-65-1538; TT-67-60255; AD-643727) CFSTI: HC $3.00/MF $0.65

The article examines the operating principle and analyzes the properties of a phase-sensitive detector employing switches and providing proportionality of conversion with simultaneous power amplication of a variable input signal. The described detector is a second-harmonic detector. It employs double conversion of the measured signal. TAB

N67-17969* Battelle Memorial Inst., Columbus, Ohio.

A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR-RADIATION ENVIRONMENT. VOLUME I: RESULTS OBTAINED ON JPL TEST NO. 617, PHASE II

C. L. Hanks and D. J. Hamman 1 Jun. 1966 263 p ref Prepared for JPL

(Contracts NAS7-100; JPL-950458)

(NASA-CR-81652) CFSTI: HC $3.00 CSCL 09A

A program was conducted to investigate and provide a measure of the effects of long-term nuclear exposure on the reliability of many types of electronic parts. The radiation environment considered was a total exposure of 10^{13} n cm^{-2} having energies above 0.1 MeV and 10^7 rads carbon of gamma rays. In addition, it was necessary to take into account the fact that the parts might also be subjected to the high vacuum of space and a possible maximum temperature of 100°C. Five sets of conditions were chosen for the test. These were: (1) a temperature of 100°C and normal atmospheric pressure, (2) a temperature of 100°C and a vacuum of approximately 10^{-5} mmHg, (3) a temperature of 100°C, a vacuum the same as (2), and exposed to radiation for a period of 10,000 hours; the total radiation exposure was 10^{13} n cm^{-2} and 10^7 rads carbon of gamma rays, (4) a temperature of 100°C, under vacuum, and the same total radiation exposure as in (3) but received in only 100 hours; the devices were then left on operational load for the balance of the 10,000-hour period with no further irradiation, and (5) a temperature of 50°C, under vacuum, and exposed to radiation under the same conditions as in (3). Author

N67-17971*# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.

PHOTON-COUPLED ISOLATION SWITCH Quarterly Report, 1 Jul.–30 Sep. 1966

E. L. Bonin 30 Sep. 1966 20 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951340)

(NASA-CR-81605; QR-3; Rept.-03-66-151) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A new integrated circuit switch is being developed using photon coupling to provide a transistor output electrically isolated from the driving sources and all other terminals of the switch. The isolation switch combines a monolithic silicon integrated driver circuit supplying bias to a gallium arsenide photo-emitting diode. The emitting diode is optically coupled to an electrically-isolated silicon phototransistor. It is reported that the design and breadboarding of the driver circuit were substantially completed. The silicon phototransistor, also designed and fabricated, demonstrated the desired current gain and breakdown voltage characteristics, but also high leakage currents at high temperatures. The latter was found to be due to inversion layer formation on the transistor surface after the GaAs emitting diode was bonded to the transistor with a coupling glass. Modifications were made to the transistor which eliminated the high leakage effects; and additional characterizations were made for the phototransistor current gain, the speed and emitting diode biasing for the driver circuit, and the bonding glass and encapsulation material. Author

N67-17981* Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.

AMPLITRON LIFE TEST UNIT Final Engineering Report

4 Nov. 1966 44 p Prepared for JPL

(Contracts NAS7-100; JPL-951412)

(NASA-CR-81614; PT-1259) CFSTI: HC $3.00 CSCL 09A

The electrical characteristics, theory of operation, mechanical description, operating procedures, and trouble shooting procedures for the amplitron life test unit are presented. The units are suitable for amplitrons QKS997A, QKS1051, QKS1200, and QKS1300. Electrical and mechanical drawings of the test unit, and an acceptance test plan and tabulated test results for amplitron QKS1300 are appended. R.N.A.

N67-17995*# Battelle Memorial Inst., Columbus, Ohio.

A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR RADIATION ENVIRONMENT. VOLUME II: THE REVISED TEST PROCEDURE

C. L. Hanks and D. J. Hamman [1966] 125 p

(Contracts NAS7-100; JPL-950458)

(NASA-CR-81607) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The complete test procedure is described for a program to determine qualitatively and experimentally the behavior of selected electronic parts in a specified radiation environment. Included are descriptions of the test specimens, test design, measurements and measurement procedures, test environments, lift-test procedures, data recording procedures, and data and failure verification procedures. Circuit operation procedures for parameter measurements using the automatic data recording system are appended along with photographs of the test facility and location of test specimens relative to the fission plate of the reactor's thermal column. R.N.A.

N67-18012*# Philco Corp., Blue Bell, Pa. Microelectronics Div.

TEST AND INSPECTION FOR PROCESS CONTROL OF MONOLITHIC CIRCUITS Final Report, 25 Aug.–25 Nov. 1966

Robert S. Slaughter 25 Nov. 1966 181 p

(Contract NAS8-21009)

(NASA-CR-81723; H-554) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The reproducibility and reliability of monolithic microcircuits depends on the degree of control maintained through the fabrication processes. Control of a typical monolithic device is provided by the In-Process Quality Control (IPQC) function. The IPQC operates as an independent evaluating agency to monitor and document the production effort. The process control effort is described in the master flow chart, which is referenced to supporting detail charts and equipment list. The process control system described is based

on a bipolar expitaxial monolithic device, including the process sequence from substrate preparation through sealing. The detail charts include the tests and inspections applied to specific process areas in which evaluation techniques are relatively standardized. It is believed that these basic techniques and equipment can be applied equally well to the characterizations necessary to qualification of other monolithic technologies, i.e., triple-diffused (non-epitaxial), complementary and unipolar (MOS type) circuits. Author

N67-18015*# General Precision, Inc., Glendale, Calif. Librascope Group.
STUDY OF FAILURE AND RELIABILITY IN MICROELECTRONIC DEVICES Fifth Quarterly Report, Sep.–Nov. 1966
Nov. 1966 10 p Prepared for NASA
(NASA-CR-81726) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Life test data are presented in tabulated form, and the mode of failure and possible screening tests are discussed. It was determined that the failure mechaniams or modes for integrated circuits are similar to those with switching type diodes and small-signal planar/passivated transistors. The most common defects were found to be surface contamination and scratches. Data indicate that the input diodes driven by the signal source were the predominant failure areas. N.E.N.

N67-18021* Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
TESTS AND INSPECTIONS FOR PROCESS CONTROL OF MONOLITHIC CIRCUITS Final Report
John L. Durso, Joseph L. Flood, and Leo Rodgers 29 Nov. 1966 111 p
(Contract NAS8-21010)
(NASA-CR-81699) CFSTI: HC $3.00 CSCL 09A

The process controls found to be effective in manufacturing high reliability silicon monolithic integrated circuits are described. Several controls are discussed for each significant production stage, covering the full range from growth of the silicon crystal to the final encapsulation of the device. The majority are designed primarily to optimize electrical characteristics and yield; those with a significant reliability aspect are wafer, die, die bond, and wire bond inspections. In addition, in-process quality assurance controls have been established at five steps: wafer pattern, sulfuric clean after oxide etch, wafer scribe and break, die bond, and wire bond. The specifications describing these controls are included. M.G.J.

N67-18047*# Goodyear Aerospace Corp., Akron, Ohio.
MICROELECTRONICS EVALUATION. SERVO LOOP ELECTRONICS Interim Report
20 Dec. 1966 22 p refs
(Contract NAS8-20205)
(NASA-CR-81709; GER-12189S7; IR-8) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Constructed was the breadboard version of a stabilized platform servo electronics system to demonstrate the compatibility of the modularly constructed segments of the system. The breadboard version was successfully demonstrated in closed-loop operation. The problems encountered and results that were obtained when the system was operated in an open-loop configuration are discussed. The loop is modularized as shown. Brief descriptions of each modularly constructed section are included in the appendix to this report. Author

N67-18048* North Carolina State Coll., Raleigh.
PARAMETRIC STUDY OF OVERSIZED RECTANGULAR WAVEGUIDES AND H-GUIDES
F. J. Tischer Dec. 1966 23 p refs
(Grant NGR-34-002-047)
(NASA-CR-81710; EML-RR-4) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The effects of the cross-sectional geometry on the attenuation due to wall losses of oversized rectangular waveguides and H-guides is considered. By properly chosen normalizations, the dependence on width, height, oversize ratio A^2/λ^2 and aspect ratio a/b are determined, optimum geometries found, and the data displayed in diagram form. The attenuation of an H-guide with infinitely thin dielectric slab with infinite permittivity is compared with that of the parallel-wall guide as reference. It is found that the dielectric slab reduces the attenuation due to wall losses by a factor depending primarily on the rate of the exponential decay of the fields in the air space. The approach of derivation permits showing clearly the causes of the decreased attenuation. Author

N67-18191 United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
STANDARD RELAY MODULES FOR SAFETY AND CONTROL CIRCUITS. PART 2: INSTRUCTION AND MAINTENANCE MANUAL
B. J. Maple and A. G. Cooper 1966 66 p
(TRG-933(R), Pt. 2) HMSO: 9s

An instruction and maintenance manual is presented for standard relay modules designed to meet the need for relay logic of experimental plants. The design can be constructed without prior knowledge of the plant requirements and can be made to suit a particular application by the simple expedient of arranging links in a removable connector. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-16930# Illinois Univ., Urbana. Coordinated Science Lab.
SUBOPTIMAL FEEDBACK CONTROL OF SYSTEMS WITH RANDOM PARAMETERS
Ronald A. Werner Sep. 1966 111 p refs
(Contract DA-28-043-AMC-00073(E))
(R-323; AD-641186) CFSTI: HC $3.00/MF $0.65

This thesis relates the theory of optimal control with the concept of sensitivity. It deals with the following problem. Suppose one wants to design an optimal controller for a system that has a variable input and contains unknown random parameters. The controller must generate an optimal control for each allowed input and all allowed values of the random parameters. However, the controller cannot measure the parameters directly; it can only measure the input to the system and the output of the system. Hence, it is a feedback controller that generates the optimal control for all allowed inputs and systems. This thesis gives a method for finding a suboptimal solution to the above problem; however, the approximation of the optimal solution can be made to any desired degree of accuracy. For, the suboptimal solution is a partial sum of an infinite series that converges to the optimal solution to the problem. Author (TAB)

N67-16942# Air Force Academy, Colo. Frank J. Seiler Research Lab.
ADAPTIVE BANG-BANG CONTROL OF AN UNSTABLE MECHANICAL SYSTEM CONTAINING AN UNKNOWN PARAMETER

John F. Schaefer *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 17 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

An adaptive control scheme is formulated for a slowly time-varying unstable mechanical system driven by a bounded controller. The control law is constrained to be of the "bang-bang" type. The adaptive control law is shown to result in stable operation for all system initial conditions lying within the region of controllability. The mechanical system analyzed consists of a rigid rod hinged at its base to a motorized cart. The problem is thus to design a controller which switches the cart motor so as to drive the cart back and forth in the proper fashion to both balance the rod and maintain the cart near its zero position, regardless of the position on the rod of the movable mass. The evolved controller operates in two modes, only the first of which is discussed in the paper. In the first, or "adapt", mode of operation, the bang-bang controller is forced to chatter. The resulting average control effort is measured and implemented to cause certain controller parameters to vary. Author

N67-16989# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

CONTROL LOGIC FOR ATTITUDE CONTROL OF A SPACE VEHICLE

Cornett Eugene Hall and John J. D'Azzo *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 38 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

The development of a torque adaptive and a time optimal control logic designed for use with an electrothermal jet thruster or similar mass-expulsion device is described. The torque adaptive control is designed to achieve attitude control within 10 minutes of arc with minimum fuel consumption. The time optimal control is designed for fast response during acquisition and maneuvering. In the fixed attitude mode the system operates in a limit cycle, and the torque adaptive control logic optimizes the thruster on-time. In a zero disturbance torque environment the limit cycle is dependent only upon the minimum on-time of the thruster. Under constant disturbance torque conditions, the limit cycle is characterized by the application of unidirectional thrust pulses. Therefore, the total impulse requirement is dictated by either the disturbance torque level or the minimum thruster on-time. Operation is demonstrated in the acquisition, maneuvering, and limit cycle modes. Step and ramp disturbance torque forcing functions, as well as pulse disturbances, are included in the digital simulation of a single-axis control system to demonstrate and evaluate the performance. Author

N67-17039# Naval Ordnance Lab., White Oak, Md.

AN ANALOG LINEAR CLASSIFICATION NETWORK Final Report

Robert J. Biegalski 27 Apr. 1966 41 p refs

(NOLTR-65-108; AD-641178) CFSTI: HC $3.00/MF $0.65

A linear network was built to classify analog signals consisting of a large number of parallel inputs. These inputs were derived by a feature abstracting system using synthetic nerve networks. In this classification network the signals pass simultaneously through a maximum amplitude filter and then are classified by a resistive memory matrix. The maximum amplitude filter attenuates smaller inputs much more than larger ones and serves to 'pick out' predominant features. This is a way of utilizing the pandemonium concept of Selfridge. Classification by linear hyperplanes is discussed briefly and then the operation and design of the maximum amplitude filter is covered. Author (TAB)

N67-17219# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A COMPUTING METHOD FOR THE LINEAR TIME OPTIMAL CONTROL SYSTEM

Tai Ju Wei, Li Pow So, and Wang Yu Yin 12 Jul. 1966 28 p refs Transl. into ENGLISH from Tzu Tung Hua Hsueh Pao (Communist China), v. 2, no. 3, 1964 p 123–135

(FTD-TT-65-1921; TT-66-62501; AD-640730) CFSTI: HC $3.00/MF $0.65

On the basis of the Principle of Invariant Imbedding, a successive approximation method is proposed to solve the linear time optimal controls subject to various constraints. Formulas for estimating the transient time are also given. An example for the nontrivial case is given. Author (TAB)

N67-17247# Naval Ordnance Lab., White Oak, Md.

SOME FUNCTIONAL NEURAL NETWORKS Final Report

James E. Swanekamp 29 Apr. 1966 48 p refs

(NOLTR-65-160; AD-641138) CFSTI: HC $3.00/MF $0.65

Several types of neural networks were constructed using a d.c. pulseless type of neuron model as a basic element. These networks were combined in the construction of a simplified one-dimensional artificial eye to demonstrate a capability for sensing direction of motion. Author (TAB)

N67-17272# Polytechnic Inst. of Brooklyn, N. Y.

THE SYNTHESIS OF NETWORKS CONTAINING LUMPED AND DISTRIBUTED ELEMENTS, PARTS I AND II

D. C. Youla, Plinio Tissi, and W. Kohler Griffiss AFB, N. Y., RADC, Oct. 1966 42 p refs Part 1 Submitted for Publication

(Contract AF 30(602)-3951)

(PIB-MRI-1323-66, Pt. 1; PIB-MRI-1323-66, Pt. 2; RADC-TR-66-489; AD-641897) CFSTI: HC $3.00/MF $0.65

The paper is devoted to the synthesis of n-ports composed of the usual passive lumped building blocks and ideal uniform transmission lines possessing identical one-way delays. It is shown that the scattering matrix, W(p,s), of such a structure is two-variable bounded-real. A complete synthesis technique is evolved for purely reactive networks by introducing the concept of a minimal realization. Moreover, it is demonstrated that such lossless networks may be constructed with the absolute minimum number of lumped reactances and lines. Several theorems are also presented delineating the fine structure of nonminimal realizations and two examples serve to illustrate the basic synthesis approach. Author (TAB)

N67-17288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN APPROXIMATE CALCULATION OF THE CONNECTIONS OF THE CONTROLLING ACTION IN SYSTEMS OF COMBINED CONTROL WHEN THERE IS INCOMPLETE DATA ABOUT THE SYSTEM

V. G. Terskov *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 90–118 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

Approximation methods based on the error coefficient equal to zero and based on the amplitude frequency characteristics of the closed system are described. The order for connecting the elements in the circuits in the control system is outlined, and the processes for adjusting or aligning the system for each method are included. N.E.N.

N67-17294# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

THE TENTH MINTA MARTIN LECTURE: APPLICATIONS OF OPTIMAL CONTROL THEORY IN AEROSPACE ENGINEERING

Arthur E. Bryson, Jr. *In* Md. Univ. Aerospace Eng. 1966 Sep. 1966 p 1–40 refs (See N67-17293 07-34) CFSTI: HC $3.00/MF $0.65

The applications of the calculus of variations and dynamic programming to deterministic, nonlinear, and time-varying systems are reviewed, and the design of optimum logical structures for guidance and control systems is examined, taking into account uncertainties in sensor measurements, control implementations, initial conditions, and external forcing functions and parameters. Consideration is given to the design of aerodynamic shapes, flight paths, deterministic and stochastic guidance and control logic, and data processing logic. Some of the examples given include: minimum drag nose shapes in hypersonic flow, minimum fuel low-thrust orbit transfer from Earth to Mars, minimum time climb path for a supersonic interceptor, minimum fuel climb paths for a supersonic airplane, explicit guidance for minimum fuel horizontal translation for a spacecraft, explicit guidance for minimum time interception for a spacecraft, and perturbation guidance for minimum energy loss of a reentry vehicle to horizontal flight at a specified altitude in the atmosphere. L.E.W.

N67-17335# Joint Publications Research Service, Washington, D. C.

PHASE FOCUSING THEORY OF KLYSTRON

Chia-Lin Hsieh and Yung-Hsian Chao *In its* Transl. on Communist China's Sci. and Technol., No. 355 19 Dec. 1966 p 17–25 Transl. into ENGLISH from the Book "Su-Tiao-Kuan Ch'un-Chu Li-Lun" Peking, Sci. Publishing House, Jan. 1966 p i–ix (See N67-17332 07-13) CFSTI: $3.00

This book discusses the related theoretical problems of the bunching phenomena of linear bundles, including the kinematical theory, the defocusing theory, the space charge wave theory, the large signal theory, etc. The major purpose is to study the direct wave type klystrons. Also included are problems of multiple bunching and wide frequency and the theoretical analyses of some phenomena commonly encountered in practical work. Besides, problems related to electricity carrying particle accelerators are also discussed as part of theoretical applications. This book may be used by researchers of electrical physics, electrical vacuum parts, engineers, and students and teachers of higher education; it may also be used as a reference reader for the study of electrical dynamics. Author

N67-17338 Joint Publications Research Service, Washington, D. C.

RECENT WORK ON PROBLEMS OF OPTIMAL SPEED AND OPTIMAL CONTROL

10 Jan. 1967 17 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 2, 1966 p 286–293 (JPRS-39475; TT-67-30125)

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2. A PROBLEM IN OPTIMAL CONTROL OF STATIONARY SYSTEMS WITH DISTRIBUTED PARAMETERS V. I. Plotnikov p 7–12 refs (See N67-17340 07-10)

N67-17339# Joint Publications Research Service, Washington, D. C.

TYPE EVALUATION OF AN INTEGRAL FUNCTION AND THE PROBLEM OF OPTIMAL SPEED

B. I. Korenblyum *In its* Recent Work on Probl. of Optimal Speed and Optimal Control 10 Jan. 1967 p 1–6 refs (See N67-17338 07-10)

For integral functions f(z) of order 1 (of the exponential type) having on the real axis $\infty > x > \infty -$ a given rate of decrease for $|x| \to \infty$, the lower type value will be established which is exact up to an absolute constant (coefficient). For purposes of this evaluation the time of optimal high speed in a control problem is determined (with accuracy up to the absolute coefficient). Author

N67-17340# Joint Publications Research Service, Washington, D. C.

A PROBLEM IN OPTIMAL CONTROL OF STATIONARY SYSTEMS WITH DISTRIBUTED PARAMETERS

V. I. Plotnikov *In its* Recent Work on Probl. of Optimal Speed and Optimal Control 10 Jan. 1967 p 7–12 refs (See N67-17338 07-10)

In this article some new theorems in the theory of optimal processes described by n-dimensional linear differential equations of the parabolic type are formulated. Systems with distributed parameters in connection with the difficulties inherent to them have been comparatively little studied. Some such problems for the simplest equation $u_t' = u_{xx}''$ have been studied. Author

N67-17366 National Bureau of Standards, Boulder, Colo.

RADIO FREQUENCY MEASUREMENTS

In its Conf. on Precision Electromagnetic Meas. 1966 p 58–71 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

Conference papers on radio frequency measurement techniques and equipment are summarized. Consideration is given to research on a 0.1–10 MHz dielectric specimen bridge with dissipation factor accuracy of $\pm 10^{-6}$, an impulse spectral intensity measurement system, a 5- to 50 MHz direct reading phase meter with hundredth degree precision, a high accuracy technique for swept measurements of time delay at rf and microwave frequencies, noise comparators and standards for S and X bands, precision power measurements of spacecraft cw signal level and microwave noise standards, and a technique for accurate rf attenuation measurements. A.G.O.

N67-17644# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RELIABILITY OF ANALYSIS OF CIRCUIT ELEMENTS BY THE REDUNDANCY METHOD

Zhen-Ming Chai 3 Aug. 1966 30 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 8, 1964 p 705–719 (FTD-TT-65-1052; TT-67-60263; AD-643922) CFSTI: HC $3.00/MF $0.65

The effectiveness of using the redundancy method to increase the reliability of circuit elements is analyzed, taking into account the possibilities of short-circuit and open-circuit failures. Formulas and curves of reliability gain under various conditions are derived from the analysis of circuit elements of both switching and nonswitching types. The effects of failures of some of the basic elements within redundancy elements in changing the loading of other elements have also been considered. Some discussion is devoted to the average life of the redundancy element, indicating that the redundancy method is particularly suitable for long-term operation or self-adapting systems. Some design considerations for practical applications are discussed in substantial detail with illustrations. Author (TAB)

N67-18013*# Stanford Research Inst., Menlo Park, Calif.

RESEARCH ON THE DESIGN OF ADAPTIVE CONTROL SYSTEMS, VOLUME I Final Report

John Peschon, Robert M. Dressler, Lewis Meier, III, and Robert E. Larson Jul. 1966 96 p refs
(Contract NAS12-59; SRI Proj. 5578)
(NASA-CR-81724) CFSTI: HC$3.00/MF$0.65 CSCL 09C

Analytical studies of performance feedback and analysis–synthesis adaptive systems are discussed. It is shown that the theory of combined estimation and control (combined optimization theory) constitutes the mathematical framework for adaptive control problems and that the adaptive systems described in the literature are approximate solutions of this general problem. The concept of measurement adaptive systems, where information is treated as a state (or resource) variable, is introduced; a general solution to this problem is derived and readily computable special cases are given. The steps of this research effort, as well as additional results pertaining to reliability and space vehicle tracking applications are summarized. The problem of maximizing the expected service rendered by a system comprising unreliable components is formulated as an optimal control problem. The minimization of errors in tracking space vehicles with large radio antennas is treated as a problem of combined estimation and control to which the linearized Kalman–Bucy–Koepcke theory is applied. A digital computer program simulating the operation of the resulting optimum tracking system was written and tested. Author

N67-18020*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON THE DESIGN OF ADAPTIVE CONTROL SYSTEMS, VOLUME 2 Final Report
John Peschon, Robert M. Dessler, Lewis Meier, III, Robert E. Larson, E. C. Fraser et al Sep. 1966 171 p refs
(Contract NAS12-59; SRI Proj. 5578)
(NASA-CR-81731) CFSTI: HC$3.00/MF$0.65 CSCL 09C

Technical memoranda relating to satellite tracking, attitude control and stabilization, and adaptive control systems are presented. The problem of minimizing tracking errors of a large radio antenna for tracking space vehicle motion is formulated as a combined optimum estimation and control problem, and the application of adaptive filtering and control techniques to satellite tracking and attitude control is discussed. Reliability was considered, and a mathematical formulation for maximizing the service provided by unreliable components is developed and shown to be solvable. A simplified design technique for model-referenced adaptive systems is presented. Analysis–synthesis adaptive systems, and the adaptive control problem in terms of combined estimation and control theory are treated. The problem of high precision tracking of space vehicles is solved by application of the theory of optimum estimation and control. N.E.N.

N67-18062# Arizona Univ., Tucson. Dept. of Electrical Engineering.
THE SOLUTION OF OPTIMAL CONTROL PROBLEMS ON AN ITERATIVE HYBRID COMPUTER
Richard Lee Maybach (Ph.D. Thesis) 1967 170 p refs

Techniques are proposed for successfully solving various optimal control problems as part of a continuing hybrid analog-digital computer study. These methods allow optimal control problems to be solved with relative dispatch. They are applicable to a wide variety of problems—those with linear, nonlinear, and time-varying system; integral and final-value criterion functions; and constrained controls and states. The problem is formulated by using Pontryagin's Maximum Principle. State equations, adjoint equations, Hamiltonian, and steepest ascent process are simulated on the analog portion of an interative hybrid computer. The analytical work is justified by hybrid computer solutions of undamped second- and third-order systems, a constrained second-order system, and Zermelo's navigation problem, all with a minimum-time criterion function and a second-order system with nonlinear damping and a minimum time-plus-fuel criterion function. Typical solution accuracies are 1–2%, and typical convergence times are on the order of a few seconds. S.P.

N67-18083*# Maryland Univ., College Park. Computer Science Center.
BUILDING BLOCKS FOR LARGE-SCALE INTEGRATION OF LOGIC CIRCUITS
Yaohan Chu Oct. 1966 29 p refs
(Grant NsG-398)
(NASA-CR-81754; TR-66-35) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This paper describes a study which has led to a set of building blocks for large-scale integration of logic circuits. The study began by designing a very simple but non-trivial stored-program digital computer. It was possible to arrange the logic circuits of the entire computer into a large matrix (a diode matrix is used as an illustration in this paper) and register blocks. This large matrix was then divided according to the micro-operations of the computer into 22 small matrices, each of which can be obtained from one universal matrix by disabling unused matrix junctions with an attempt to have one matrix perform just one micro-operation. The idea of integration of both circuits and logic, not circuits alone, is thus shown. A set of two building blocks for large-scale integration of logic circuits is proposed: a matrix chip for performing micro-operations and a register chip for storing a binary word. Alternatively, matrix chips and combination chips (on the latter of which both the matrix and the register are fabricated) can be used, following the same design and basic layout. Author

N67-18157*# Perkin-Elmer Corp., Norwalk, Conn.
DEVELOPMENT OF AN ALL DIELECTRIC INFRARED BEAMSPLITTER OPERATING IN THE 5 TO 30 MICRON REGION
P. L. Heinrich, R. C. Bastien, A. DosSantos, and M. Ostreich Washington, NASA, Feb. 1967 116 p refs
(Contract NAS5-9560)
(NASA-CR-703) CFSTI: HC$3.00/MF$0.65 CSCL 20F

The design, development, and fabrication procedures are described for three infrared beamsplitter assemblies, which have the optical and mechanical characteristics necessary for use in an interferometer spectrometer carried in a Nimbus B satellite. Of the five substrates examined, KBr was found to be the most promising material for operation between 5 and 30 μ in spite of a program of substrate absorption beyond 22 μ. Potential beamsplitter film designs were computed and curves predicting optical performance are presented. The fabrication of a prototype beamsplitter and compensating element is described, as well as the design, fabrication, and testing of beamsplitter mounts. Mounted beamsplitters were tested for their survival ability and performance characteristics. Weathering tests indicated that the beamsplitter consistently survives 70% ± 3% relative humidity for 24 hr at 30°C. Recommendations were made for an unsupported (substrateless) beamsplitter to extend the operational range to 50 μ, eliminate the need for path compensating elements, and increase system performance while decreasing weight. L.E.W.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-16721*# Martin Co., Denver, Colo.
INVESTIGATION OF THE RELIABILITY OF STERILE INSERTION TECHNIQUES FOR SPACECRAFT Final Report
L. Sullivan and C. Wehrenberg Oct. 1966 58 p refs
(Contract NASw-1407)
(NASA-CR-81316; VOY-CR-66-9) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The feasibility of gnotobiotic insertion techniques using flexible film isolators for potential application in the assembly and repair of sterile spacecraft was investigated. Sterile parts were transported through a highly biologically contaminated area into a sterile environment to study the insertion technique reliability. Both sterile lock and split seam insertion techniques have demonstrated repeatable performance without contamination of either parts or the sterile internal environment. It is concluded that adaptation of this gnotobiotic technology to spacecraft application appears to be a potentially valuable avenue of investigation. It is also reported that flexible isolators are practical devices for gnotobiotic applications using peracetic acid. A.G.O.

N67-16728*# General Dynamics/Convair, Huntsville, Ala.
AUTOMATIC MALFUNCTION ANALYSIS BY DISCRETE NETWORK SIMULATION
Oct. 1966 97 p refs
(Contract NAS8-20016)
(NASA-CR-81313; GD/C-DDF-66-007) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Automatic malfunction analysis data has been generated using Discrete Network Simulation (DNS) for selected networks of the Saturn 1C stage. The prime purpose of DNS methodology is to provide a set of analytical tools capable of conducting thorough and rapid analysis of complex systems. DNS techniques and their application are presented, and the three computer programs which operate and activate the model are described. The instructions for building a DNS model are also included. A.G.O.

N67-16848# Polytechnic Inst. of Brooklyn, N. Y.
MICROWAVE RESONANT CAVITY MEASUREMENT OF SHOCK PRODUCED ELECTRON PRECURSORS
S. Lederman and D. Wilson *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 196-197 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

It is reported that an enlarged section of 10-inch diameter was added to a 1-inch shock tube in an investigation of the influences of the shock tube walls in precursor ionization experiments. C.T.C.

N67-16856# Polytechnic Inst. of Brooklyn, N. Y.
FUTURE WORK IN THE 6-IN SHOCK TUBE AND MINIATURE SHOCK TUNNEL NOZZLES
M. H. Bloom, S. Lederman, and J. Overberger *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 240-242 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65
(Grant NsG-409)

Continuing work on establishing the effective running time with miniature Mach 6 and 12 hypersonic nozzles is reported. The running times are of the order of about 1 msec with air and 2 msec with argon. A schematic of the shock tube and a photo of a probe rake for incident shock measurements are included. C.T.C.

N67-16949# Arnold Engineering Development Center, Arnold Air Force Station, Tenn. Propulsion Div.
IMPULSE FACILITIES FOR SCRAMJET RESEARCH AND DEVELOPMENT
Forrest B. Smith, Jr. *In its* Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 27 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

SCRAMJET testing requirements including component investigations as well as full system test requirements are discussed. Two general classes of impulse facilities which have been useful for SCRAMJET research and development are the reflected shock tunnel and the hotshot tunnel. A third impulse facility, the "chemical shot," which utilizes the chemical reactions of various propellant combinations in a constant volume reaction chamber as a means of producing high enthalpy and high pressure "simulated" air, has potential. Results of analytical and experimental studies in the use of the reflected shock tunnel, research to ascertain the feasibility of using air as the test gas in the inductively driven hotshot tunnel, and finally the progress to date on the "chemical shot" idea are presented. Author

N67-16950# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.
SUPERSONIC COMBUSTION SIMULATION FOR HIGH MACH NUMBER FLIGHT
Robert G. Dunn and Emil J. Walk *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 52 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

A method of simulation is presented which makes possible the investigation of supersonic combustion for hypersonic flight under conditions essentially duplicating those of actual flight. The laboratory conditions necessary to simulate supersonic combustion occurring in vehicles moving with Mach numbers of 10 to 14 at altitudes of 100,000 to 200,000 feet are presented in the form of tables and graphs. Methods for scaling experimental results to the flight conditions are discussed. It is concluded that separate investigation of Scramjet combustor problems can yield highly significant results. It is further concluded that adequate supersonic combustion simulation under prolonged test conditions, in or near the region of flight Mach numbers 10 to 14, is practical with facilities presently available. Author

N67-16980# Rome Air Development Center, Griffiss AFB, N. Y. Mechanical Engineering Section.
DEVELOPMENT OF A UNIQUE MOBILE INTEGRATED SUPPORT SYSTEM FOR TACTICAL ELECTRONICS
Maurice N. Scheiderich and Anthony N. Ciancio *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 30 p (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

The mobility, weight and bulk, set-up time, electric power, and package handling requirements of a mobile integrated support system (MISS) to be used in transporting electronic equipment, are specified. A design analysis of the integrated system is compared to a conventionally supported system. Significant design features of the integrated system which are described, include the vehicular drive system, the diesel engine power system, the multiple output gear box, the alternator, and the suspension system. The MISS can be used to transport any electronic equipment package installed in an S-141 type shelter, with a total package weight of 4000 lbs. The support system can be lifted and transported by helicopter as a unit. L.S.

N67-16987# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
OPTIMUM MAGNETS FOR MHD GENERATORS
Robert R. Barthelemy and Charles E. Oberly *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 24 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

Areas of applicability for permanent, conventionally cooled resistive, cryogenically cooled resistive, and superconductive magnets to open cycle MHD power generation systems are identified. Combustion driven MHD generators utilizing continuous electrode Faraday, segmented electrode Faraday, and Hall configurations are investigated. Relationships are derived between the net power output of any MHD system and the field strength and geometry of its magnet. The effect of magnet characteristics and generator design on the overall efficiency and various energy losses of the system is considered. The relationships are used to select the type, design, and characteristics of the magnet which optimizes the cost and weight of the generation system for each point on the net power spectrum. The cost, weight, and power requirements of magnet cooling systems are calculated and included in the magnet design criteria. The selection of magnet types for stationary and mobile systems as well as for short and long duration systems is made. Results for the three types of MHD generators are plotted on power duration and net power output coordinates to show the economical operating regimes of the various types of magnets. Both a weight and cost optimum regime are shown for the entire MHD generator operating range. Author

N67-16988# Air Force Eastern Test Range, Patrick AFB, Fla. Directorate for Range Engineering.

AUTOMATION IN THE NEW EASTERN TEST RANGE CENTRAL TELEMETRY STATION (TEL-IV)

John L. Gilbert *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 40 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

The Air Force Eastern Test Range Central Telemetry Station, Tel-IV, is described. The equipment pool design concept backed by the automatic central control system makes Tel-IV the most versatile and complete telemetry station in the world. It is capable of supporting seven missions simultaneously, including prelaunch, launch, orbital, and post-mission data processing capabilities. With the remote patch control subsystem, turn around time to set up for a new mission is limited only by the time required to calibrate and check out the individual subsystems. Tel-IV has sufficient telemetry equipment to meet all known and planned range user requirements and schedules. The display rooms can record and display over 900 channels of data in real time. The real-time telemetry data system ties Tel-IV into the downrange and mobile telemetry stations for display and recording of selected channels of data in near-real time. R.N.A.

N67-16994# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.

SIMULATION OF LOW ALTITUDE CLEAR AIR TURBULENCE FOR AUTOMATIC FLIGHT CONTROL DESIGN

Norval P. Taylor *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 39 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

The low altitude clear air turbulence simulation presented is directly applicable to 10:1 time scale optimization studies of fully automatic landing systems for the supersonic transport and supersonic bombers. The turbulence model as generated is likewise directly applicable to 50:1 time scale simulations of high speed, low level automatic terrain avoidance studies. The step by step procedure of utilizing a random noise generator and other general purpose analog computer equipment to simulate the earth's surface winds is described. Among the more important items presented is an analog computer technique to establish the spectral shape of a noise generator. Results of this technique applied to a random noise generator are given. The graphic design methods of synthesizing a turbulence spectral shaping filter from minimum phase components in three-terminal networks achieving a cascade effect are described with illustrations. Emphasis is placed on the development of the lateral component of the wind. Author

N67-17024# Naval Ordnance Lab., White Oak, Md.

AXISYMMETRIC NOZZLE FLOWS INCLUDING NON-EQUILIBRIUM EFFECTS

K. R. Enkenhus *In its* Theoret. Inviscid Fluid Mech. 28 Sep. 1966 32 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

The methods used at NOL for designing wind tunnel nozzles for high-temperature gas flows are reviewed. The mathematical techniques discussed include the method of characteristics for equilibrium and non-equilibrium air, a series expansion solution for transonic flow, and numerical and analytic studies of one-dimensional non-equilibrium flow. Some recommendations are given for future work. Author

N67-17124 Polish Academy of Sciences, Warsaw.

HIGH-VACUUM CASCADE PUMP SYSTEM [KASKADOWY UKLAD WYSOKOPROZNIOWY]

Zbigniew Kozlowski and Marek Sadowski Jul. 1966 35 p refs In POLISH; ENGLISH summary (INR-740/XVIII/PP) CFSTI: $3.00

The principles of design and construction of a cascade pump system with the final vacuum $5 \cdot 10^{-8}$ torr and a pumping speed of 300 liter/sec are discussed. A functional diagram and details of main elements, i.e., an oil baffle, a vacuum cold trap, high-vacuum straight-run valves, and a multi-way block valve, are described. An applied method of pumping speed measurements and results of exploitation testing are given. It has been corroborated that the high-vacuum cascade pump system is useful for laboratory and industrial activities. Author

N67-17180# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIENCE IN USING A VACUUM CHAMBER FOR TESTING ACCURATE MIRRORS OF ASTRONOMICAL INSTRUMENTS

V. A. Savin *In its* New Tech. in Astronomy 6 Apr. 1966 p 12-18 (See N67-17168 07-14) CFSTI: HC $3.00/MF $0.65

Various methods of testing fine optics are discussed, in relation to the difficulties created by optical heterogeneities of the air in the test facility. Details are given on a vacuum chamber technique for testing flat mirrors 0 to 500 mm. The experimental data show that the test takes place with specific reliability and synonymity; nonheterogeneous air streams are absent, and heat transmission to the mirror through convection streams and direct ray emission is eliminated. Two knives with vertical and horizontal blades can be used simultaneously. This assures shadow chart determination of local errors in horizontal and vertical sections of the tested mirror, as well as errorless determination of its astigmatic errors. M.G.J.

N67-17671# Los Alamos Scientific Lab., N. Mex.

CHARACTERISTICS AND EXPERIMENTAL PROGRAM FOR AN 800 MeV PROTON LINEAR ACCELERATOR

D. E. Nagle [1966] 12 p refs (Contract W-7405-ENG-36) (LA-DC-8144) CFSTI: HC $3.00/MF $0.65

A review is presented of a number of meson factory projects around the world. The operating characteristics of the Los Alamos

Linear Accelerator are discussed along with characteristics of primary and secondary beams. A summary of the experimental program at Los Alamos is included. NSA

N67-17617*# Firestone Tire and Rubber Co., Akron, Ohio. Defense Research Div.

DEVELOPMENT AND TESTING OF ADVANCED SHAPED CHARGE METEORITIC SIMULATORS. PART I: SHAPED CHARGE DESIGN AND DEVELOPMENT

E. R. Berus and E. L. Clark [1966] 169 p refs

(Contract NAS1-5212)

(NASA-CR-66215) CFSTI: HC$3.00/MF$0.65 CSCL 14B

In an attempt to develop meteoritic simulators by employing shaped charges which explosively propel metal jets, experiments were conducted with conventional conical shaped charges as well as a newly developed hyperbolic shaped charge design. Materials used were 1020 steel, ingot iron, type 200 nickel, 304 stainless steel, and magnesium. Jet velocities in the range of 8.0 to 12 km/sec were observed for the jets from the various materials; some of these jets were in a stable cohesive form, while others were fragmented and expanding radially. No cohesive nickel jets were produced with velocities above 11 km/sec, and no cohesive iron jets were produced with velocities as high as 9 km/sec. Nickel and iron shaped charge designs were produced which were calibrated for future rocket flight tests. Author

N67-17618*# Firestone Tire and Rubber Co., Akron, Ohio. Defense Research Div.

DEVELOPMENT AND TESTING OF ADVANCED SHAPED CHARGE METEORITIC SIMULATORS. PART II: CALIBRATION OF FLIGHT GUNS

R. L. Woodall and E. L. Clark [1966] 110 p

(Contract NAS1-5212)

(NASA-CR-66216) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Statistical data were obtained on the mass, shape, and velocity of two types of shaped charge meteor simulator guns. Flash radiographs of the meteor pellets were taken in low ambient pressure environment to simulate reentry conditions, so that pellet characteristics could be measured. The methods of radiographic analysis are described. One type of gun was found to produce nickel pellets with an average velocity 9.54 km/sec and average mass 0.88 gram. The other type of gun was found to produce iron pellets with average velocity 8.56 km/sec and average mass 0.82 gram. Author

N67-17684# California Univ., Livermore. Lawrence Radiation Lab.

ASTRON ALIGNMENT SYSTEM

Eugene T. Bradley 23 Sep. 1966 12 p Presented at the Symp. on Eng. Probl. of Controlled Thermonucl. Res., Gatlinburg, Tenn., 3–6 Oct. 1966 Submitted for Publication

(Contract W-7405-ENG-48)

(UCRL-70025; CONF-661016-2) CFSTI: HC$3.00/MF$0.65

The continuing development of the Astron device is discussed. The alignment techniques for using the new 4-MeV accelerator are briefly discussed. NSA

N67-17753# ARO, Inc., Arnold Air Force Station, Tenn.

DESCRIPTION AND PERFORMANCE OF A MOLECULAR BEAM CHAMBER USED FOR CRYOPUMPING AND ABSORPTION PUMPING STUDIES Technical Report, Jun. 1965–May 1966

R. F. Brown and J. H. Heald, Jr. Arnold Eng. Develop. Center, Oct. 1966 37 p refs

(Contract AF 40(600)-1200)

(AEDC-TR-66-135; AD-641388) CFSTI: HC$3.00/MF$0.65

An aerodynamic molecular beam chamber was constructed and operated. Design criteria, performance data, and space simulation applications are discussed. Cryopumping was utilized to provide the required pumping speed and to reduce the scattering of the beam by the background gas. A maximum beam intensity of 2.0 x 10 to the 20th power CO2 molecules per second per steradian was measured. The beam is now being used to study basic cryopumping phenomena on a microscopic scale and to provide capture coefficient data for immediate application in the design of cryopumping systems for space simulation chambers. Author (TAB)

N67-17817 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).

WORK REPORT 1963-1965 OF THE INSTITUTE OF EXTRA-TERRESTRIAL PHYSICS AT THE MAX-PLANCK-INSTITUTE OF PHYSICS AND ASTROPHYSICS [TAETIGKEITSBERICHT 1963–1965 DES INSTITUTS FUER EXTRATERRESTRISCHE PHYSIK AM MAX-PLANCK INSTITUT FUER PHYSIK UND ASTROPHYSIK]

Jan. 1966 59 p refs In GERMAN

(MPI-PAE-Extraterr.-22/66)

Starting with the development of the institute since its foundation in 1963, its constructions and scientific staff complement, this work report then briefly mentions the special technical installations such as agitator, space simulator, centrifuge, vacuum evaporation chamber and finally reviews its main activities: scientific work and technical developments. The main work is concentrated, due to the institute's origin, on problems in physics and astrophysics to be dealt with by means of balloons, sounding rockets, satellites and space probes and necessitating extensive laboratory experiments. On the other hand, owing to the near neighborhood of the Institute of Plasma Physics, much work is done on extraterrestrial plasmas, with main emphasis on interplanetary plasma, the so-called solar wind. The report finishes with enumeration of those scientific groups and organizations with which the Institute co-operates fruitfully. ESRO

N67-17829*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SUPERCONDUCTIVE MAGNETS AT LEWIS RESEARCH CENTER OF NASA

James C. Laurence Washington, NASA, 1967 22 p refs Presented at the Intern. Cryogenic Eng. Conf., Kyoto, 9–13 Apr. 1967

(NASA-TM-X-52269) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Construction details and performance data of special-purpose, superconductive magnets planned and in use at the Lewis Research Center of NASA are presented. The magnets described include: a pair of 2.5-tesla force-reduced toroids, 30 centimeters in diameter with a winding cross section 2.5 centimeters in diameter; a 15-centimeter-bore magnetic bottle with 5-tesla mirrors; a 2.5-tesla center coil, and a quadrupole Ioffe coil producing a cusp field; and a 6.25-centimeter-bore, 10-tesla solenoid. Author

N67-17856# Chicago Univ., Ill. Fluid Dynamics and Sediment Transport Lab.

A SINGLE-IMPULSE SYSTEM FOR GENERATING SOLITARY, UNDULATING SURGE, AND GRAVITY SHOCK WAVES IN THE LABORATORY

Robert L. Miller and Robert V. White Jun. 1966 51 p refs
(Contract Nonr-2121(26))
(TR-5; AD-643823) CFSTI: HC$3.00/MF$0.65

A piston type system was devised to create single-impulse wave for laboratory study. These include solitary waves, undulating surge and gravity shock waves. y sub 2/y sub 1 values as high as 4.0 were obtained, which for a still water depth (y sub 1) of 0.4 would result in a y sub 2/y sub 1 ratio of 1.6. Details of design and construction are given. Calibration and comparison of observed vs. expected wave properties are discussed. Included are application of strobe flash and high speed motion picture techniques.
Author (TAB)

N67-17920# Air Force Academy, Colo.
THE FRANK J. SEILER RESEARCH LABORATORY
Jul. 1966 56 p
(AD-641986) CFSTI: HC$3.00/MF$0.65

Topics include: introduction to the Mission, background and accomplishments of the Frank J. Seiler Research Laboratory at the United States Air Force Academy; publications and presentations during FY. 66; current research projects; bibliographies of staff members. Research is being carried out in the following general areas: system optimization, programming and control; fluid dynamics; physical and organic chemistry.
TAB

N67-17960# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
TESTING OF REFLECTIVE MARKERS FOR INDICATING THE THRESHOLD AND CENTERLINE OF RUNWAYS FOR SMALL AIRPORTS Interim Report
N. H. Twichell and Cecil B. Phillips Dec. 1966 28 p
(FAA-RD-66-71)

Technical tests were performed to investigate the usefulness of retroreflective markers in improving runway threshold and centerline identification at small airports. During the hours of darkness, retroreflective markers were more effective in indicating the centerline than was the painted centerline. Retroreflective markers were less effective in indicating the threshold than were the threshold lights. These markers are not be considered as a replacement for either the centerline or threshold lights. The effectiveness of the markers is a function of the intensity, location and aiming of the aircraft landing lights in relation to the line of sight of the pilot. The markers are inexpensive, easy to install and to maintain.
Author

N67-18032* United Technology Center, Sunnyvale, Calif. Research and Advanced Technology Dept.
MODELING AND GROWTH OF RELIABILITY-EXTENDED MODEL Interim Technical Report
W. J. Corcoran 15 Nov. 1966 72 p ref
(Contract NAS7-356)
(NASA-CR-81692; UTC-2140-ITR) CFSTI: HC$3.00 CSCL 14D

In extending the Monte Carlo type computer simulation model, a different approach to the reliability change after a failure or successful test was incorporated to (1) allow for some fraction of noncorrectable failures; and (2) introduce two options. One permits simulation of the effects of testing under various degrees of extreme and relaxed environments; the other (through a block change system) allows for delays in making changes. The basic model, programmed in Algol for the Burroughs 5500 computer, is described. Simulation variables and related input parameters are listed, and a typical form for transmitting input information to the computer operator for a simulation run is included. Examples are given to illustrate the effects of various input parameters and simulation options. Three predictive reliability growth models are qualitatively evaluated and compared with simulation results. It is generally concluded that none of the models can be expected to give uniformly good performance for all hypothetical reliability growth situations.
M.G.J.

N67-18148*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPERATIONAL FEATURES OF THE LANGLEY LUNAR LANDING RESEARCH FACILITY
Thomas C. O'Bryan and Donald E. Hewes Washington, NASA, Feb. 1967 40 p refs
(NASA-TN-D-3828) CFSTI: HC$3.00/MF$0.65 CSCL 14B

The design features of the Langley lunar landing research facility (LLRF) are described. This facility provides the capability for flying a piloted vehicle in a simulated lunar-gravity field and is presently being used to obtain detailed information relative to the flight dynamics of the Apollo lunar module. Operational procedures and results of a typical flight test are discussed to show the manner in which the facility is utilized. Some of the operational characteristics of the servocontrolled systems which produce the simulated lunar gravitational field are illustrated. Over 150 flight-test operations have been performed to date with 9 research pilots and astronauts, who have all reported the sensations of actual free flight during the test operations. Approximately 2 minutes of sustained flight are possible by use of the hydrogen peroxide main rockets in the vehicle. This time capability exceeds the time required for the Apollo lunar module to accomplish its terminal maneuver or to touch down on the lunar surface from about 150 feet (45.7 meters). Continuous monitoring of the servo-systems has indicated satisfactory simulation of the lunar gravity, and pilots of the vehicle report negligible effects of the visual cues afforded by the facility structure.
Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-16776# Aeronautical Research Council (Gt. Brit.)
SIMPLE THEORETICAL AND EXPERIMENTAL STUDIES OF THE FLOW THROUGH A THREE-SHOCK SYSTEM IN A CORNER
E. Eminton London, HMSO, 1966 25 p refs
(ARC-CP-727; AD-800211) CFSTI: HC$3.00/MF$0.65

In the hope of finding the three-shock system in a given corner appropriate to flow at a given Mach number a very simple theoretical model is considered. It assumes that shocks and streamlines are all straight and concentrates on the flow in the region of the point where the main shock branches into two. A shear layer is allowed to originate there and conditions imposed to match both pressures and flow directions on either side of it. The results of the calculations suggest that a more sophisticated theory is needed and a few experiments are made to substantiate this. Theory and experiment together lead to the conclusion that the shock system in a corner is determined not by the way the flow behaves around the branch point but by its behaviour around the feet of the branches which lie within the boundary layer. Thus, viscous effects dominate the flow field and the external inviscid part of the flow appears to be able to accommodate itself readily by small deviations from the simplified model considered here.
Author (TAB)

N67-16778# Aeronautical Research Council (Gt. Brit.)
MEASUREMENT OF TURBULENCE IN THE LIVERPOOL UNIVERSITY TURBOMACHINERY WIND TUNNELS AND COMPRESSOR
R. Shaw, A. K. Lewkowicz, and J. P. Gostelow London, HMSO, 1966 29 p refs
(ARC-CP-847; AD-800217) CFSTI: HC $3.00/MF $0.65

The measurement of the turbulence intensity in three wind tunnels and a research compressor is described and the minimum values are found to be 0.401% for the No. 1 tunnel, 0.256% for the No. 2 tunnel, 0.363% for the boundary layer tunnel and 2.19% for the compressor. It was found that the effect of the upstream gauze was critical. Results for the tunnels and compressor after installation in a new building confirmed the above values for the tunnels, but indicated 1% turbulence. TAB

N67-16822# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
PROPAGATION OF SPHERICAL SHOCK WAVES IN RADIATING DYNAMICAL SYSTEMS
Zdenek Kopal Aug. 1966 37 p refs Its Mathematical Note No. 475
(D1-82-0555; AD-641124) CFSTI: HC $3.00/MF $0.65

A mathematical treatment is presented of spherical blast waves in a radiating gaseous medium. Radiation as well as gas is considered to contribute to the energy and momentum transfer; and their interaction is taken into account on the basis of the form of the energy-stress tensor which is exact as long as the squares and higher powers of a ratio of the velocity of gas to that of light can be ignored. Author (TAB)

N67-16832# Polytechnic Inst. of Brooklyn, N. Y.
KINETIC-THEORETICAL BASES OF DYNAMICS OF GASES (STOCHASTIC PROCESSES IN GASEOUS SYSTEMS)
T. Koga *In its* Res. of Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 54–56 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Summary information is presented on research concerned with the stochastic nature of kinetic theoretical processes which occur in gases exhibiting gas-dynamical phenomena. The particles constituting the gas are assumed to be classical-mechanical, and of low density and high energy. Background information is included for Gibb's statistical mechanics and the kinetic theory of gases constructed by Maxwell and Boltzmann. C.T.C.

N67-16833# Polytechnic Inst. of Brooklyn, N. Y.
CHARGE PARTICLES IN A SUPERFLUID
D. D. H. Yee *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 56–57 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

It is reported that a hard sphere model which describes the qualitative features of liquid helium has been extended to include an impurity interacting with the system. This model was devised with reference to previous experiments in which a new type of elementary excitation in the form of vortices was observed in experiments concerned with the motion of an ion in liquid helium. In the proposed model, the low-lying excited states are density fluctuations or phonons, and the interaction of the impurity with the system is treated as a perturbation. C.T.C.

N67-16851# Polytechnic Inst. of Brooklyn, N. Y.
TIME-DEPENDENT SECOND-ORDER DIFFERENCE ANALYSIS OF ONE-DIMENSIONAL RELAXING FLOW
E. L. Rubin *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 208–209 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65
(Contract Nonr-839(34))

A brief discussion is given of how many of the "physical" effects are in reality physical and how many are due to the viscosity introduced by the numerical difference scheme in solving Navier-Stokes equations in one dimension. C.T.C.

N67-16853# Polytechnic Inst. of Brooklyn, N. Y.
THE BHATNAGAR-GROSS-KROOK EQUATION AS AN APPROXIMATION OF THE BOLTZMANN EQUATION. PART II: COMPARATIVELY FEASIBLE APPLICATIONS
T. Koga *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 213 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Conditions are given under which the Bhatnagar–Gross–Krook equation may be used as an approximation of the Boltzmann equation. This is applicable in a case of rarefield gas dynamics where the collision effect is a minor perturbation factor in the result. C.T.C.

N67-16860# Navy Underwater Sound Reference Lab., Orlando, Fla.
THE EFFECTIVENESS OF A SPLITTER PLATE IN REDUCING TRANSVERSE OSCILLATIONS OF A FINITE CIRCULAR CYLINDER IN TURBULENT FLOW
Robert I. Welsh, Jr. 30 Sep. 1966 93 p refs
(USL-759; AD-642621) CFSTI: HC $3.00/MF $0.65

A right circular cylinder moving through a viscous fluid and oriented so that the longitudinal axis is normal to the flow is acted upon by drag forces, opposite to the direction of motion, and by alternating lift forces, transverse to the direction of motion. Studies on cylindrical bodies, having large-length-to-diameter ratios when end effects do not influence the spanwise flow pattern (infinite cylinders), show that the transverse forces are caused by vortex or shedding from the body at subcritical and transcritical Reynolds numbers and by the randomly turbulent wake at supercritical Reynolds numbers. It has been previously shown that a splitter plate placed in the wake behind infinite cylinders is an effective means of suppressing vortex shedding at subcritical and transcritical Reynolds numbers. This investigation studied the drag and oscillating lift forces at supercritical Reynolds numbers on a circular cylinder with a length-to-diameter ratio of 1.5 (i.e., a finite cylinder). Drag coefficients were computed and compared to those for infinite cylinders and were found to agree fairly well with the results of Delaney and Sorensen. A splitter plate with a chord length equal to one cylinder diameter was placed in three positions behind the cylinder, and drag and lift forces were measured to determine the best plate position for reducing drag and suppressing wake-induced transverse oscillations. Author (TAB)

N67-16965# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
APPLICATION OF NUCLEONIC MASS MEASUREMENT TECHNIQUES FOR MEASUREMENT OF TWO-PHASE FLUID CONDITIONS EXISTING IN AIRCRAFT FLUID SYSTEMS
Harry W. Schmidt *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 28 p refs (See N67-16982 07-34) CFSTI: HC $3.00/MF $0.65

An investigation of various measurement techniques revealed the potentiality of utilizing nucleonic mass measurement techniques for aeration detection in the T-34 lubrication system. Descriptions of the principles of radiation attentuation of radiation in matter, detection techniques, and system accuracy are given. In-house testing efforts proved the validity of the measurement technique, but proved the available hardware inadequate for actual flight test aeration measurements. A basic description of the nucleonic equipment and the test results are discussed. The development goals and applications of the across-the-board type nucleonic instrument are described. Anticipated benefits that nucleonic mass measurement technique will have on future design and testing of aircraft fluid flow systems are described and include specification updating as a result of the increased knowledge of fluid flow characteristics, and improved assurance that new aircraft designs will meet oil aeration and fuel V/L (vapor–liquid ratio by volume) specification requirements. Author

N67-17021# Naval Ordnance Lab., White Oak, Md.
THEORETICAL INVISCID FLUID MECHANICS
R. E. Wilson, comp. 26 Sep. 1966 126 p refs Proc. of a Seminar held in White Oak, Md., 14 Jun.–21 Jul. 1966 (NOLTR-66-191; AD-642771) CFSTI: HC $3.00/MF $0.65

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N67-17022# Naval Ordnance Lab., White Oak, Md.
INCOMPRESSIBLE STEADY FLOW AROUND ARBITRARY BODIES OF REVOLUTION
R. C. Roberts *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 7 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

Considered is the axisymmetric uniform flow of an incompressible inviscid fluid past a body of revolution. The body contour is generated by a smooth curve with the nose of the body being either blunt or pointed. The flow is rotational and has a velocity potential which satisfies Laplace's equation. The pressure in the flow is obtained by introducing the transformation $x - t = y(x) \cot \theta$ into the integral equation from zero to infinity of $(U(x)\sin^2 \theta\, d\theta)/2 \sin(\theta - \gamma(x)) = 1$ where γ is the angle between the x-axis and the tangent to the body surface, U is the total velocity, and x is the axial coordinate. The variable x depends on the particular body being considered. Three example calculations are given for the: (1) flow over a prolate ellipsoid; (2) flow over a pointed body generated by a parabolic arc; and (3) the flow over a sphere. G.G.

N67-17023# Naval Ordnance Lab., White Oak, Md.
STEADY STATE DETONATIONS
H. M. Sternberg *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 1 p ref (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

The main problem treated here is the calculation of the pressure transmitted when a plane detonation front impinges obliquely on a metal plate. Depending on the impact angle and the properties of the explosive and the metal, the adjustment at the boundary will take place through normal reflection, oblique regular reflection, Mach reflection, or Prandtl-Meyer expansion. Our general method has been the construction of separate pressure vs. streamline deflection diagrams for each metal and explosive at each impact angle. Various problems are then solved graphically by superimposing these diagrams and using the condition that the pressure and streamline direction must be continuous across a contact discontinuity. Our results show that the calculated pressure transmitted into iron is 396 kilobars for headon impact, drops to 370 when the impact angle is 63.4°, abruptly jumps to 452 kilobars as Mach reflection starts, and then falls off rapidly. For military applications where the loading of the metal is important, both reflected shocks and Mach reflection can be avoided by using grazing detonations where the impact angles are between 80 and 90 degrees. Author

N67-17025# Naval Ordnance Lab., White Oak, Md.
SHOCK MITIGATION
James L. Rand *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 6 p (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

Various vehicles may be vulnerable to pressure pulses which are of sufficient magnitude to cause failure of vital components of the system. Therefore, it is necessary to protect these systems by the addition of a shock mitigating device which will lower the forces experienced by the rest of the structure. One promising method of accomplishing this mitigation makes use of the propagation of stress waves through a non-linear medium. It has been found that an unsteady one-dimensional flow approximation is sufficiently accurate to predict mitigation due to wave interaction. Author

N67-17026# Naval Ordnance Lab., White Oak, Md.
UNSTEADY ONE DIMENSIONAL FLOWS
Arnold E. Seigel *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 29 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

Discussed are three examples of one-dimensional unsteady flow analyses. Parts I and II are problems related to the hydrodynamic shocktube. In the hydrodynamic shocktube, a driver gas is used to propel water. The actual experimental performance of the hydrodynamic shocktube was different from that predicted by the usual shocktube theory; hence, the effect of the flexibility of the tube wall of the shocktube and the effect of a possible small amount of air in the water was investigated. Part III is a brief summary of the calculation method used to predict the performance of its two-stage light gas guns. Author

N67-17027# Naval Ordnance Lab., White Oak, Md.
TRANSIENT EXPLOSION HYDRODYNAMIC CALCULATIONS IN ONE SPACE DIMENSION
W. A. Walker *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 6 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

One-dimensional inviscid flow equations were used to calculate transient hydrodynamic explosion waves in free water, air, and vacuum; plate-push problems in which a detonating explosive accelerates a metal plate; and shock tube phenomena. Also analyzed was the interaction of a spherical shock wave from an underwater explosion with the plane surface of the water. G.G.

N67-17028# Naval Ordnance Lab., White Oak, Md.
GROWTH OF DETONATIONS
Julius W. Enig *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 2 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

Numerical experiments are described which show that the initiation of detonation in homogeneous explosives is the result of shock heating and that the initiation process is basically one of thermal explosion. The particular problem considered deals with the one-dimensional idealized explosive gap test consisting of a donor explosive separated from an acceptor explosive by a gap of inert material. For a fixed length of donor explosive there exists a critical length of inert which if exceeded will not lead to detonation of the acceptor explosive by the shock wave originating in the donor. The problem is to find the critical gap length and the processes that occur in the acceptor explosive which lead to

detonation. This has been done and the numerical results are in qualitative agreement with the experimental results. These numerical solutions will be shown in the form of movies in which the fluid motion will be followed. Author

N67-17029# Naval Ordnance Lab., White Oak, Md.
AXIALLY SYMMETRIC TRANSIENT EXPLOSION OF HYDRODYNAMICS
D. Piacesi, Jr. *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 11 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

The hydrodynamic equations for transient, isentropic flow can be solved numerically by the von Neumann–Richtmyer finite difference method. In this method, an artificial dissipative term is introduced into the conservation equations of energy and momentum. This causes shocks to be spread over a finite thickness and allows the flow variables in the region of a shock to change abruptly, but continuously. Solutions to axially symmetric, time dependent, explosion hydrodynamic problems have been obtained with the use of a computer program called CYCLONE. Given is a general description of the CYCLONE code. This includes a discussion of the necessary input (initial and boundary conditions) and the form of the output available from the program as well as the results of calculations for the flow problem which is summarized below. *Problem:* Calculate the flow resulting from the detonation of a 2-inch diameter cylinder of Pentolite explosive, where the initiation is at a point on the central charge axis at one end face. Author

N67-17030# Naval Ordnance Lab., White Oak, Md.
NUMERICAL METHODS FOR THE CALCULATION OF NUCLEAR EXPLOSIONS
M. Lutzky *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 7 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

Methods will be given for the calculation of the blast shock resulting from a nuclear explosion for various models which can be chosen to represent the explosion. The simplest possible representation of a nuclear explosion is obtained by considering that a finite amount of energy is deposited instantaneously at a given point. If it is further assumed that the resulting shock is very strong, so that the ambient pressure may be assumed to be zero, then dimensional analysis is sufficient to yield results for the conditions at the shock front. Author

N67-17125# Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany).
PROBLEMS OF TURBULENT JET DIFFUSION IN A BASE FLOW [ZUR PROBLEMATIK DER TURBULENTEN STRAHLAUSBREITUNG IN EINER GRUNDSTROEMUNG]
H. Reichardt Nov. 1965 55 p refs In GERMAN
(Rept.-35) CFSTI: HC $3.00/MF $0.65

The turbulent flow of an axial jet on a base flow is somewhat similar to a turbulent wake behind a rotating body. This phenomenon is the subject of the present paper. The widening of the jet flow is calculated, taking into account the added impulse due to contributions from the base flow. An analysis of new experimental results concerning the formation of head flow and turbulent wakes leads to the conclusion that speed variations in the direction of the flow show a stronger decrease than the fluctuations in turbulence. Transl. by K.W.

N67-17234# National Physical Lab., Teddington (England). Aerodynamics Div.
ON VORTEX STREET WAKES
P. W. Bearman 18 Apr. 1966 33 p refs
(NPL-AERO-1199; ARC-28143; AD-642149) CFSTI: HC $3.00/MF $0.65

The flow in the wake of a two-dimensional blunt-trailing-edge model was investigated in the Reynolds number range 1.3 x 10 to the 4th to 4.1 x 10 to the 4th. The effects of splitter plates and base bleed on the vortex street were examined. Measurements were made of the longitudinal spacing between vortices and the velocity of the vortices, and compared with values predicted by von Karman's potential vortex street model. The lateral spacing was estimated by using both the von Karman and Kronauer stability criteria. The new universal wake strouhal number is devised, using the value of lateral spacing predicted by the Kronauer stability condition as the length dimension. A correlation of bluff body data was found when pressure drag coefficient times strouhal number was plotted against base pressure. Author (TAB)

N67-17298# Aeronautical Research Associates of Princeton, Inc., N. J.
A BRIEF REVIEW OF RESEARCH ON THE IMPINGEMENT OF AXIALLY SYMMETRIC FREE JETS
Coleman duP. Donaldson *In* Md. Univ. Aerospace Eng. 1966 Sep. 1966 p 74–110 refs (See N67-17293 07-34) CFSTI: HC $3.00/MF $0.65

A brief survey of research carried out in the field of jet impingement is presented, with emphasis on the behavior of flow in the strong interaction region of jet impingement and the initial formation of the surface half-jets or wall jets that emanate from this region. Details are given on the experimental apparatus, the free jet, and normal and oblique impingement problems. Consideration is also given to a theoretical investigation of the normal impingement of rotational flows. Extensive illustrations are included. L.E.W.

N67-17299# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
CHEMICAL NON-EQUILIBRIUM EFFECTS ON HIGH SPEED FLOW
Freeman K. Hill *In* Md. Univ. Aerospace Eng. 1966 Sep. 1966 p 111–124 refs (See N67-17293 07-34) CFSTI: HC $3.00/MF $0.65

The measurement of a simple reacting gas system is considered as it passed from a state of thermodynamic equilibrium to a nonequilibrium condition by flowing through a nozzle. The energy release of the nozzle gases was studied, and, because it was known that the freezing process prevented some of the energy from being transferred to kinetic energy, the chemical nonequilibrium forces occurring in rocket nozzles were investigated. Details are given on the experimental apparatus, the spectra obtained, and the method for translating the data into compositional determinations from which the nonequilibrium properties were found. Results indicated that the reacting gas freezes out downstream of the throat (or stops reacting and remains fixed in composition) so that the state of the gas is then not in thermal equilibrium. The predictions of kinetic theory were found to be valid as applied to nozzle flow of reacting gas mixtures. L.E.W.

N67-17300# Maryland Univ., College Park. Dept. of Aerospace Engineering.
A STUDY OF TANGENTIAL SLOT INJECTION IN SUPERSONIC FLOW
Harold E. Gilreath and Joseph A. Schetz *In its* Aerospace Eng. 1966 Sep. 1966 p 125–152 refs (See N67-17293 07-34) CFSTI: HC $3.00/MF $0.65
(Grant NSF GK-310)

Studies are reported of supersonic injection into a two-dimensional low Reynold's number supersonic stream, with the additional conditions of matched static pressures and constant wall temperature. The experiments were conducted in a Mach 2.1 atmospheric intake wind tunnel, using a Mach–Zehnder interferometer. All tests were run with air-to-air injection, and the principal results are presented in the form of density profiles at various stations in the flow field. Descriptions are given of the wind tunnel, test model, instrumentation, and flow visualization apparatus. Results indicated that for subsonic injection into a supersonic stream the instability of the flow was pronounced. With a Reynold's number at the point of injection roughly one-tenth of that associated with transition on a flat plate, a fully turbulent

mixing region occurred. The mixing region intercepted the wall boundary layer eight to nine slot heights downstream. Therefore, by using a relatively small number of successive slots, thermal protection and skin friction reduction could be provided over a large region. L.E.W.

N67-17320# Royal Aircraft Establishment, Farnborough (England).
SIMPLE DETERMINATION OF MACH NUMBER [VEREINFACHTE ERMITTLUNG DER MACHZAHL]
E. Nickel Oct. 1966 22 p Transl. into ENGLISH from Arch. Tech. Messen (Munich), no. 356, Sep. 1965 p 193–196
(RAE-LIB-TRANS-1184) CFSTI: HC $3.00/MF $0.65

The note derives approximate equations relating Mach number to the ratio of dynamic pressure to static pressure. The exact equations are difficult to solve and the approximations allow one quantity to be obtained readily from the other to an accuracy which satisfies normal practical requirements. Author

N67-17328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STABILITY OF A ROTATING LIQUID MASS
John A. O'Keefe *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 155–169 refs (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

The fission of a rotating liquid mass of constant density was analyzed by considering a rotating fluid body which was constraint by an ellipsoid. It was shown that certain ellipsoids are in fact equilibrium configurations, and that as the angular momentum of these spheres increased, a series of stable configurations were passed until intersected by another set. It was concluded that these spheres were stable up to the point where they encounter the series of Jacoby ellipsoids. G.G.

N67-17396# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF COMPUTER MATHEMATICS AND MATHEMATICAL PHYSICS Selected Articles
24 Jun. 1966 45 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 3, 1964 p 495–511; 604–610
(FTD-MT-65-582; TT-66-62497; AD-640726) CFSTI: HC $3.00/MF $0.65

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N67-17397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUMERICAL CALCULATION OF TURBULENT MIXING OF TWO HOMOGENEOUS GAS FLUXES
P. P. Koryavov *In its* J. of Computer Math. and Mathematical Phys. 24 Jun. 1966 p 1–25 refs (See N67-17396 07-12) CFSTI: HC $3.00/MF $0.65

The boundary layer equation is derived to approximate the turbulent mixing of two homogeneous fluxes of compressible fluid with different Prandtl numbers. The temperatures and velocities of the mixed fluxes are reviewed, and it is stated that this relationship is very convenient for comparison of laminar and turbulent mixing flows with the same parameters of the mixed fluxes, as well as for establishing the influence of change of each of these parameters and also the Prandtl number, and the specific heat capacity pressure constant on the flow. R.Li.

N67-17398# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF NUMERICAL CALCULATION AND SOLUTION OF THE PROBLEM OF DISPERSION OF A FLAT LAYER OF GAS DURING GRADUAL NONUNIFORM ENERGY RELEASE
A. S. Fonarev *In its* J. of Computer Math. and Mathematical Phys. 24 Jun. 1966 p 27–38 refs (See N67-17396 07-12) CFSTI: HC $3.00/MF $0.65

A system of equations is derived for gas dynamics in the presence of internal sources of heat absorption in the form of integral laws of conservation to illustrate the method of calculating gas dispersion during nonuniform energy release. In the case of nonadiabatic flows with discontinuities, a one-dimensional variant is introduced. Application is to the study of shock waves. R.Li.

N67-17486# Los Alamos Scientific Corp., N. Mex.
DISSIPATION AND CRITICAL VELOCITIES IN SUPER FLUID HELIUM
E. F. Hammel and W. E. Keller [1966] 47 p refs Presented at 10th Intern. Conf. on Low Temp. Phys., Moscow
(Contract W-7405-ENG-36)
(LA-DC-8165; CONF-660816-1) CFSTI: HC $3.00/MF $0.65

For the flow of an ordinary fluid it is well known that the entropy production may be expressed in terms of a dissipation function and the heat flux. In liquid He II the existence of two separate velocity fields introduces additional complexities into the problem of describing the entropy production processes. The relationships between these processes in He II and those in ordinary fluids are demonstrated by a discussion of the following topics: viscous dissipation by the normal fluid, with emphasis on thermal flow; dissipation due to a mutual force between the superfluid and the normal fluid; dissipation associated with turbulent normal fluid flow; dissipation due solely to the superfluid flowing through narrow channels and in the film. It is shown how each of these cases may be described analytically and separately identified from the experimental flow measurements. For each type of entropy production there is a critical fluid velocity at which the corresponding dissipation process begins to appear. In the past there has been considerable ambiguity in identifying these velocities from the observed changes in the flow properties of He II systems. However, it is now possible to distinguish and to characterize properly the various critical velocities, and the manner in which this may be done is described. Author (NSA)

N67-17510*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MERCURY DROPLET SIZE AND DISTRIBUTION IN GLASS CONDENSER TUBE IN 1-G AND ZERO-GRAVITY ENVIRONMENTS
Jonas I. Sturas Washington, NASA, Feb. 1967 67 p refs
(NASA-TM-X-1338) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An experimental study was made of mercury droplet size and flux distribution in a horizontal convectively cooled glass mercury vapor condenser tube in 1-g and zero-gravity environments. The film analysis showed that the liquid phase was dispersed throughout the vapor phase in the form of discrete droplets, even in the higher vapor-quality range studied. The dispersed droplet breakup and coalescence in two-phase flow occurred simultaneously and continuously along the length of the condenser tube. The observed droplet size distribution was best described by the modified gamma distribution function. Droplet size and flux distribution obtained from a series of high-speed film measurements, at various velocities and quality conditions along the tube length, were described statistically and fitted to a modified gamma distribution. The numerical values of three characteristic parameters that describe the gamma distribution curve varied with vapor velocity and quality. The critical droplet size measured from a droplet track left on a condenser wall at its incipient movement and the maximum stable droplet size measured in a turbulent vapor stream were essentially linear functions of vapor quality and vapor velocity. Author

N67-17567# Oak Ridge National Lab., Tenn.
THEORETICAL SLIP RATIOS IN ANNULAR TWO-PHASE FLOW
R. P. Wichner. 9 May 1966 25 p ref
(Contract W-7405-ENG-26)
(ORNL-TM-1519) CFSTI: HC $3.00/MF $0.65

An expression for the slip ratio (i.e., the ratio of the mean vapor velocity to that of the liquid) in annular two-phase flow is developed under the assumptions of laminar flow in the liquid film and non-rippling of the interfacial surface. The solution is presented for up, down, and zero-gravity flow in terms of the following three dimensionless quantities: (1) the vapor volume fraction, (2) a parameter, B, depending on the liquid and vapor physical properties, tube radium, and friction factor of the vapor flow, and (3) an interfacial shear stress parameter. The critical condition for zero net liquid upflow is specified as occurring when the interfacial shear stress parameter is equal to a derived function of the volume fraction. Liquid velocity profiles and volumetric flow rates are also derived. Numerical values of the slip ratio for saturated water at 212°F and potassium at 1850°F are found to have the same trends with quality as the prediction of Lockhart-Martinelli, and are remarkably close in magnitude considering the simplicity of the model. Author (NSA)

N67-17628*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE EVALUATION OF A 4.59-INCH RADIAL-INFLOW TURBINE OVER A RANGE OF REYNOLDS NUMBER
William J. Nusbaum and Charles A. Wasserbauer. Washington, NASA, Feb. 1967 17 p refs
(NASA-TN-D-3835) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A 4.59-inch tip diameter radial inflow turbine was studied to determine the effect of Reynolds number on performance. The investigation was conducted with cold argon over a range of inlet pressures from 4.4 to 24.0 pounds per square inch absolute corresponding to Reynolds number from 64,000 to 352,000 at equivalent design speed and pressure ratio. At each value of turbine inlet pressure, data were taken at equivalent design speed over a range of pressure ratios. There was a slight increase in equivalent weight flow with an increase in Reynolds number. At equivalent design speed and pressure ratio, the maximum deviation was less than 2.0% of the design value of 0.616 pound per second. The total efficiency at equivalent design pressure ratio, which increased from about 0.85 to 0.88 with increase in Reynolds number, was attributed entirely to a decrease in viscous losses since rotor reaction appeared to be independent of Reynolds number. Author

N67-17627*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT-TRANSFER ANALYSIS FOR LIQUID-METAL FLOW IN RECTANGULAR CHANNELS WITH HEAT SOURCES IN THE FLUID
Robert M. Inman. Washington, NASA, Feb. 1967 42 p refs
(NASA-TN-D-3837) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Forced-convection heat transfer to slug flow in rectangular channels with uniform heat sources in the fluid was analyzed for aspect ratios from one to infinity. Both uniform wall heat flux and temperatures were considered; and the results are applicable in the thermal entrance region as well as in the fully developed region. In general, wall temperature distributions for specified wall heat fluxes are sensitive to the channel aspect ratio. For the slug flow velocity distribution, wall to bulk temperature differences for specified wall heat fluxes are independent of internal heat generation rate. It is conjectured that with a nonuniform velocity profile, the internal source will have only a slight influence on this temperature. Thermal entrance length is quite sensitive to channel aspect ratio and wall heating conditions. Bulk temperature development in channels with uniform temperature along all walls is influenced by channel aspect ratios up to about 10; and beyond this, the influence of aspect ratio is only slight. M.W.R.

N67-17629*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
PREDICTIONS OF SHOCK-LAYER RADIATION FROM MOLECULAR BAND SYSTEMS IN PROPOSED PLANETARY ATMOSPHERES
Henry T. Woodward. Washington, NASA, Feb. 1967 49 p refs
(NASA-TN-D-3850) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Concentrations of radiating molecules and radiation from a number of band systems are presented for equilibrium shock-layer temperatures and densities of vehicles entering proposed Martian and Venusian atmospheres. The atmospheres selected consist of various proportions of CO_2, N_2, and A. Charts relate these equilibrium shock-layer properties to flight velocity and ambient density through the normal shock conservation equations. These data can be used to estimate stagnation-point radiative heat transfer for entry trajectories. Estimates for some flight conditions are discussed and compared. Author

N67-17655# New York Univ., N. Y.
DEPT. OF AERONAUTICS AND ASTRONAUTICS. A REVIEW OF SOME PROBLEMS IN TURBULENT MIXING Interim Report
Herbert Fox, Victor Zakkay, and Ram Sinha. Sep. 1966 68 p refs
(Contract DA-31-124-ARO-D-259)
(NYU-AA-66-63; AROD-5020-3; AD-640627) CFSTI: HC $3.00/MF $0.65

A critical review of turbulent far wake experiments is presented. All the available data at M = 3, 3.89, 5, 11.18 are surveyed with a view to prediction of transport properties. There are indicated considerable difficulties in finding a single diffusion model adequate to describe the flow field. Author (TAB)

N67-17701# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SEPARATION OF SUBMICRON CONDENSATE PARTICLES IN A VORTEX CHAMBER
Eugene C. Fletcher, George Gyarmathy, and Siegfried H. Hasinger. Nov. 1966 122 p refs
(ARL-66-0218; AD-643766) CFSTI: HC $3.00/MF $0.65

Experimental results were obtained on the separation of submicron-size particles (water droplets and ice particles) from a carrier gas (air) in 'reversed-flow' swirl chambers, the separation efficiency, with droplets of about 0.3 micron diameter, was found to vary between 25% and 90%, depending mainly on the relative humidity of the inlet flow. The low values occurred at low humidities when the droplets were vaporized before they reached the enriched exit; the highest values resulted at highly supersaturated chamber conditions when the particles were prevented from revaporization. In order to facilitate the understanding of the complex phenomena taking place in the chamber, visual observations, optical particle size measurements and, in the exhaust passages, detailed flow investigations were carried out. These studies established a reasonably consistent picture of the flow, condensation, and separation processes in the chamber. Author (TAB)

N67-17712# Naval Weapons Lab., Dahlgren, Va.
MEASURED VERSUS COMPUTED SURFACE WAVE TRAINS OF A RANKINE OVOID
A. V. Hershey. 7 Jun. 1966 75 p refs
(NWL-2036; AD-641888) CFSTI: HC $3.00/MF $0.65

Measured elevations in the wave train of a Rankine ovoid are compared with computed elevations for an ideal source and sink. The measured elevations are in phase with the computed elevations but have smaller amplitudes. The discrepancy in amplitude is attributed to turbulent boundary layer and wake in the flow around the real ovoid. Author (TAB)

N67-17759# Western Co. of North America, Dallas, Tex. Research Div.
EFFECT OF POLYMER COATING ON DRAG REDUCTION Final Report
Gail T. Pruitt, Bernard Rosen, and H. R. Crawford Aug. 1966 122 p refs
(Contract Nonr-4306(00))
(DTMB-2; AD-642441) CFSTI: HC $3.00/MF $0.65

Tube flow data indicate that the drag reduction of high molecular weight polymer solutions decreases in an orderly fashion with increased molecular coiling of the polymer. A correlating equation for this effect is presented. For three polymers at four concentrations the maximum drag reduction was obtained at temperatures less than 105F and at 140F solutions of all three polymers suffered a decrease in drag reduction. A graphical relationship is presented that qualitatively correlates the variation of viscosity and drag reduction caused by a variation in temperature. A decrease in drag reduction occurs if low concentration of high molecular weight polymers are subjected to steady state turbulent tube flow. A slow decrease in viscosity of high molecular weight solutions due to physical adsorption on the solid surfaces in glassware as well as chemical degradation during static storage can be mitigated by adding isopropanol or using deionized water. The average molecular weight of different samples of the same polymer can vary by as much as 50 percent. Author (TAB)

N67-17766*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
AN ELECTROHYDRODYNAMIC INDUCTION PUMP
James R. Melcher [1965] 31 p refs
(Grant NsG-368)
(NASA-CR-70405) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An electrohydrodynamic traveling-wave induction interaction is shown to pump slightly conducting liquids (electrical conductivities 10^{-5} to 10^{-15} $(\Omega-m)^{-1}$) without electrical contact with the flow. A gradient in fluid conductivity perpendicular to the direction of flow is required. Here, this is provided by a liquid interface, which is exposed to a traveling potential wave imposed by means of a segmented electrode parallel to the interface. Induced charges relax through the liquid to form a traveling-wave of surface-charge on the interface which lags the wave of image surface-charges on the electrode. Hence, a time-average electrical surface-traction is produced tending to make the fluid move with the traveling-wave. Expressions for the fields, the time average electric traction and the fluid velocity (in plane flow) are derived and discussed. Experiments illustrate the validity of these equations, and tend to support the model used for the interfacial conduction process. Author

N67-17796*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE CENTERED ONE-DIMENSIONAL UNSTEADY EXPANSION OF A VIBRATIONALLY RELAXING NITROGEN–OXYGEN MIXTURE
Laurence N. Connor, Jr. and Frances W. Taylor Washington, NASA, Feb. 1967 48 p refs
(NASA-TN-D-3805) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The one-dimensional unsteady expansion of a mixture of gases is analyzed for conditions at which the deexcitation of molecular vibrational energies is the predominant rate process. Methods of calculation are formulated for treating the expansion as either an equilibrium or a nonequilibrium process. In the nonequilibrium analysis the method of characteristics is applied in a Lagrangian frame of reference, and the simultaneous vibrational deexcitation of a number of molecules can be handled. Calculated results for equilibrium and nonequilibrium expansions are presented for a range of initial temperatures from 2000°K to 4000°K. The velocity, thermodynamic-property, and vibrational-energy variations are presented along specific particle paths designed by the scaling parameter. The general trends seen in the results agree well with trends expected from physical reasoning and are very similar to those exhibited by vibrationally relaxing flow in a hypersonic nozzle. Curves are presented to permit practical applications of the calculated results. Author

N67-17797*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALCULATION OF THE CENTERED ONE-DIMENSIONAL UNSTEADY EXPANSION OF A REACTING GAS MIXTURE SUBJECT TO VIBRATIONAL AND CHEMICAL NONEQUILIBRIUM
Laurence N. Connor, Jr. Washington, NASA, Feb. 1967 44 p refs
(NASA-TN-D-3851) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A method of calculation based on a previously developed method-of-characteristics approach is presented for use in analyzing the nonequilibrium one-dimensional unsteady expansion of a reacting mixture of gases. The characteristic equations are written in a general form which permits the consideration of a number of rate processes. A multicomponent gas model with a number of simultaneous rate processes is used, and both chemical and vibrational nonequilibrium are permitted. A procedure which utilizes the method of characteristics in a Lagrangian frame of reference is programed to yield solutions on the IBM 7094 electronic data processing system. Calculations are presented for a typical unsteady expansion to demonstrate the use of the program. Author

N67-17798*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF SHOCK-WAVE IMPINGEMENT ON THE HEAT TRANSFER ON A CYLINDRICAL LEADING EDGE
Robert S. Hiers and William J. Loubsky Washington, NASA, Feb. 1967 refs
(NASA-TN-D-3859) CFSTI: HC $3.00/MF $0.65 CSCL 01A

This report describes an experimental study of the influence of shockwave impingement on leading-edge heat-transfer and flow-field characteristics at a Mach number of 14. Heat-transfer measurements were obtained on the cylindrical leading edge of a blunted flat plate model at sweep angles of 0°, 22.5°, and 45°. Average heat-transfer rates as high as 2600 W/cm^2, more than 10 times the value with no shock impingement, were measured in small localized regions on the stagnation line of the upswept leading edge. The results suggest that this extreme interaction-induced effect on heat transfer is associated with the impingement of a vortex sheet or slip line onto the leading edge. Heat-transfer rates 2-1/2 times the corresponding undisturbed value were measured over large spanwise segments of the stagnation line with leading edge swept 45° with respect to the free stream. Intermediate values of maximum heat transfer were obtained with the leading edge swept 22.5°. These values are apparently associated with the separation phenomena that occur on the shock-generator plate. Author

N67-17838*# Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering.
OSCILLATIONS IN TWO-COMPONENT TWO-PHASE FLOW Final Report, Volume I
A. H. Stenning and T. N. Veziroglu Feb. 1967 98 p refs
(Grant NsG-424)
(NASA-CR-72121) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The stability of two-component two-phase flow has been investigated both analytically and experimentally. In analytical work, solutions for three different systems of growing complexity have been obtained. The theoretical results are presented as stability maps, showing the relationships between density changes, dynamic pressure, pressure drops, mixer length, and inlet and exit ducting lengths at the boundaries of stable and unstable regions of operation. In experimental work, air and water were used as two-phase mixture components in a downward flow geometry for several ducting configurations. Agreement was obtained between theoretical and experimental results. Author

N67-17839*# Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering.
FLOW OSCILLATIONS IN FORCED CONVECTION BOILING Final Report, Volume II
A. H. Stenning and T. N. Veziroglu Feb. 1967 164 p refs
(Grant NsG-424)
(NASA-CR-72122) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The stability of flow in forced-convection boiling in a horizontal, electrically heated tube has been investigated experimentally using Freon-11 and water as the test fluids. Two major modes of oscillation have been identified and studied analytically, with major emphasis on the conditions governing the onset of instability. Variations in heat transfer during oscillations appear to have a strong effect on stability. Author

N67-17852*# Toronto Univ. (Ontario).
SONIC LINE IN NONEQUILIBRIUM NOZZLE FLOWS
Duvvuri Tirumalesa [1965] 13 p refs Submitted for Publication
(Grant NsG-633)
(NASA-CR-70208) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An equation valid in the region where the partially frozen Mach number is near unity is derived for the flow of a gas which is in dissociational nonequilibrium but where vibration and rotation are in equilibrium with translation (partially excited). From the solution of this equation for nozzle flows, it is shown that the constant velocity curves in the sonic region are parabolic, and thus a parabolic arc can be taken as the initial data curve for supersonic flow computations when using the method of characteristics. The curves of the limiting characteristic, the partially frozen sonic line and the line of horizontal velocity are all shown to be parabolic. The results are valid for slight departures from equilibrium. Author

N67-17921# Centre de Recherches et d'Essais de Chatou (France).
BED-MATERIAL TRANSPORT STUDY BY TRACERS [ETUDE DU CHARRIAGE D'UN ECOULEMENT PAR TRACEURS RADIOACTIFS] Final Report
J. Danion and M. Hauzel 1966 34 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-019-62-12 IRAF)
(EUR 3130.f, vol. IV) CFSTI: HC $3.00/MF $0.65

The methods of measuring bed-material movements in a waterway, more particularly the center-of-gravity method, were studied in a laboratory channel. Luminescent and radioactive tracers were used, thereby involving widely differing test procedures. In addition, a study program on the transport of bed-material in the Loire, at the site of the EDF 4 nuclear power plant, was carried out in 1963 with a view to the sedimentological calibration of the model constructed in the laboratory for the purpose of defining the lay-out of the water intake. The application of this technique has necessitated the construction of special apparatus which will have to be modified and adapted to the nature of the sediment under study as regards both the injection and the detection of the tracer. Author

N67-17957# Ling-Temco-Vought, Inc., Dallas, Tex.
TURBULENCE MEASUREMENTS IN PIPE FLOW OF A DRAG-REDUCING NON-NEWTONIAN FLUID
C. S. Wells, Jr., J. Harkness, and W. A. Meyer Dec. 1966 43 p refs
(Rept.-0-71000/6R-22)

Results of an experimental study of the streamwise component of turbulence in turbulent pipe flow of a drag-reducing non-Newtonian fluid are given. Measurements were obtained in flows of a 0.5% solution of sodium carboxymethylcellulose (CMC) in water, and for pure water for purposes of comparison. Results show that: (1) The variation of turbulence intensity with Reynolds number at the tube centerline for the CMC solution, water, and air is the same over the range of these experiments; (2) Turbulence intensity at the centerline, when normalized with the shear velocity, does not vary with Reynolds number; (3) The frequency-dependent turbulent energy spectra for the solution of CMC and for water differ in that the low-frequency energy is less for the CMC solution than for water and the high-frequency energy is greater for the CMC solution than for water; and (4) The wave-number dependent energy spectra for water, CMC, and air contain most of the turbulent energy in about the same range of the dimensionless wave-number, kD, where k is wave-number and D is pipe diameter. Experiments indicate a need for additional turbulence data with more effective drag-reducing fluids to determine whether the local turbulence intensity is correlated for various fluids by local mean velocity or the shear velocity (wall shear stress). Author

N67-18049*# General Dynamics/Convair, Huntsville, Ala.
THEORETICAL STUDIES OF PROPELLANT BEHAVIOR IN THE STATE OF WEIGHTLESSNESS
L. L. Fontenot 15 Dec. 1966 41 p refs
(Contract NAS8-20364)
(NASA-CR-81711; GDC-DDF-66-010) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Two analyses are given for predicting the motion of a heavy liquid enclosed in a partly filled prismatic cylinder which is itself in motion, under the joint action of effective body forces, surface and interfacial tension forces. One is strictly numerical in nature and yields the free surface, velocity potential, etc., as functions of time. The other is a perturbation approach whereby the free surface, velocity potential and motion of the tank are assumed to be small deviations from a known equilibrium reference state. Extension of the latter analysis to vessels possessing rotational symmetry but otherwise arbitrary seems to be possible. Author

N67-18057# Joint Publications Research Service, Washington, D. C.
A GAS-DYNAMICS CALCULATION OF AN INSTALLATION WITH A LIGHT PISTON
R. L. Petrov 26 Jan. 1967 11 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 248, 1965 p 132–138
(JPRS-39865; TT-67-30314)

The construction of an installation with a light piston was analyzed by determining the path of the piston and of the shock wave in relation to time, the parameters of the gas behind the shock waves reflected from the end of the tube, and the gas parameters between the tube's end and the piston when the latter was in a state of equilibrium. These values determined the parameters of the gas when it expanded in a nozzle of a given size, and the time of discharge. Example computations were performed for the dynamic parameters of a light piston device employing heated helium as the propelling substance. G.G.

N67-18156* Aerojet-General Corp., Sacramento, Calif.
HEAT TRANSFER TO CRYOGENIC HYDROGEN FLOWING TURBULENTLY IN STRAIGHT AND CURVED TUBES AT HIGH HEAT FLUXES
Washington, NASA, Feb. 1967 134 p refs
(Contract SNPC-35)
(NASA-CR-678) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The forced convection heat transfer characteristics of cryogenic hydrogen were studied at pressures ranging from 800 to 1500 psi and fluxes from 8 to 27 Btu/in.^{2}sec. The tests were conducted under conditions simulating those predicted for the Phoebus-2 nozzle, in support of the nozzle development program, and the test data were compared with the film temperature equation. This equation, with a modified coefficient, represented both the straight and curved tube test data. The dependency of the coefficient in terms of coolant temperature C_L and geometrical configuration (i.e., radius of curvature and angular distance for curved tubes) was empirically evaluated, and the selection of a variable C_L as a multiplying factor for modifying the coefficient in the straight and curved portions of the nozzle, respectively, was substantiated. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-16714*# Geological Inst., Helsingfors (Finland).
EVOLUTION IN GEOLOGICAL TIME
Bjoern Kurtén *In* NAS-NRC Ideas in Mod. Biol. 1965 p 327–354 refs (See N67-16701 07-04) Available from Nat. Hist. Press, Garden City, N. Y.: $8.00

In relation to the direct geological evidence on the origin of life, several paleontological processes are reviewed. During pre-Cambrian and Cambrian times, mention is made of: a model with prebiotic cyclic reactions in ponds enriched with carbon compounds, the metabolic fractionation of sulphur isotopes, fossil remains of animal phyla. Examples are given of patterns of adaptive radiation, evolution and parallel evolution. Depicted are some trends and reversals in trends concerning Silurian and Devonian tribolites, and Lituitid nautiloids. Species modification, integration, and saltation are briefly considered, and the evolution of the ostracod genus *Cytherelloidea* in the lower Cretaceous of Germany is traced graphically. R.L.I.

N67-16818*# National Aeronautics and Space Administration, Washington, D. C.
POLYCHROMATIC POLARIMETRY OF LIGHT IN THE TWILIGHT AND DAYTIME SKY AT THE ZENITH
V. V. Avramchuk *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 97–104 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

The author gives the results of polarimetric observations of the twilight and daytime sky at the zenith for 12 spectral regions in the 355–600 mμ band. The degree of polarization is tabulated as a function of wavelength and solar zenith distance. Author

N67-16991# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
THUNDERSTORM LIGHTNING
Edward Miller *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 23 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

An F-100F aircraft was flown into thunderstorms over the Southcentral and Southern sections of the United States to get the aircraft struck with lightning as much as possible and to permanently record particular information concerning these lightning strikes. The prototype test instrumentation package had numerous sensing elements located on a majority of those sections of the aircraft which were known to be vulnerable to lightning strikes. The test package proved to be quite a reliable means of obtaining data on lightning strikes to aircraft at altitude. As a result of the project, approximately 15 lightning strikes were filmed striking the various aircraft components while correlating data on the discharge current, time duration to half value and the characteristic wave shapes were permanently recorded via the other test equipment. Author

N67-16999# American Meteorological Society, Boston, Mass.
IGY AND IGC DATA ON VERTICAL WIND SHEARS IN JET STREAMS OVER THE SOUTHERN USSR [VERTIKAL'NYE SDVIGI VETRA V STRUINYKH TECHENIIAKH NAD IUGOM SSSR PO MATERIALAM MGG I MGS]
M. V. Burkova and P. Z. Levina Bedford, Mass., AFCRL, Oct. 1966 19 p refs Transl. into ENGLISH from Tr. Srednesz. Gos. Univ. (Tashkent), v. 19, no. 34, 1964 p 26–37
(Contract AF 19(628)-3880)
(T-R-612; AD-643357) CFSTI: HC $3.00/MF $0.65

The paper examines studies of vertical wind shears in arctic-front, polar-front, and subtropical jet streams made in winter and summer in the period 1957 through 1959. Calculations are made of the distribution of frequencies of various gradations of vertical wind shears above and below jet streams and the relations between the wind force on the jet-stream axis and the vertical wind shears are plotted. Author (TAB)

N67-17019# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
RESEARCH IN GEODETIC GRAVIMETRY [ISSLEDOVANIYA PO GEODEZICHESKOY GRAVIMETRII]
M. S. Molodenskiy et al Aug. 1966 138 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Geodezii, Aeros'yemki i Kartografii (Moscow), issue 86, 1951
(ACIC-TC-1043; TT-66-62581; AD-641753) CFSTI: HC $3.00/MF $0.65

Contents: Method of joint processing gravimetric and geodetic data for the study of the earths gravitational field and its figure, by M. S. Molodenskiy; The theory of orthometric, dynamic and normal heights, by V. F. Yeremeyev; On the question concerning the derivation of errors of representation and interpolation, by A. L. Bayborodin; Investigation of the plumb-line deviations and derivation of the quasigeoidal figure in the caucasus, by L. P. Pellinen. TAB

N67-17090# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ABYSSAL STRUCTURE OF THE BALTIC SHIELD ACCORDING TO GEOPHYSICAL INVESTIGATION DATA [GLUBINNOYE STROYENIYE BALTIYSKEGO SHCHITA PO DANNYM GEOFIZICHESKICH ISSLEDOVANIY]
L. Ye. Shustova [1966] 18 p refs Transl. into ENGLISH from Sov. Geol. (USSR), no. 5, 1966 p 47–57
(ACIC-TC-1109; TT-66-62582; AD-641754) CFSTI: HC $3.00/MF $0.65

The paper discusses the block structure of the earths crust of the Baltic shield. TAB

N67-17094# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGULAR VARIATIONS OF CONTENT OF ELECTRONS IN THE LOWER PART OF LAYER F_2 OF THE IONOSPHERE AT THE MIDDLE LATITUDES
L. A. Shchepkin 30 Jun. 1966 20 p refs Transl. into ENGLISH of the publ. "Ionosfery i Rasprostraneniya Radiovoln" Moscow, Izd. An SSSR, 1963 p 66–74
(FTD-MT-65-489; TT-66-62493; AD-640722) CFSTI: HC $3.00/MF $0.65

A profile of high-altitude electron distribution density in the ionsphere was obtained by consideration of geseous photoionization and the disappearance of free charges in recombination processes. The effective coefficient of ion recombination was determined basically by the vertical distribution density of the molecular gases O_2 and N_2; its concentrations determined the soeed of the ionic exchange reactions that produced the molecular ions O_2 and NO^+. The model of a parabolic layer was used to trace diurnal and seasonal variations of electron midday magnitude and calculation results showed good agreement with the nature of diurnal variations; in periods of low level solar activity the difference between winter and summer daytime levels of ion formation was about 90 km, and the difference between equinoctial and summer daytime levels was 130 km. G.G.

N67-17097# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
RESONANCES OF THE THIN-SHELL MODEL OF THE EARTH-IONOSPHERE CAVITY
David B. Large Sep. 1966 50 p refs
(ARPA Order 183)
(IER-7; ITSA-7; AD-642775) CFSTI: HC $3.00/MF $0.65

A model of the earth-ionosphere cavity at ELF in which the ionosphere is replaced by a thin, anisotropic shell is analyzed. An approach for including the effect of a static, dipolar magnetic field is outlined, and numerical results are presented which display the effect of a static, radial magnetic field. The numerical techniques involved in the solution of the model equation are outlined briefly.
Author (TAB)

N67-17099# Ionosphären-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, OCTOBER–DECEMBER 1965 [IONOSPHAREN-DATEN VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131, OKTOBER–DEZEMBER 1965]
Dec. 1965 125 p In GERMAN and ENGLISH
(Rept.-232-F; Rept.-233-F; Rept.-234-F) CFSTI: HC $3.00/MF $0.65

Presented are tables of vertical ionospheric sounding data. Tabulation sheets show the punchcard code of the characteristics given, together with month and year of observation. All echo soundings were obtained October through December, 1965, in Freiburg, Germany.
G.G.

N67-17152# Naval Radiological Defense Lab., San Francisco, Calif.
TRANSMISSIVITY OF THE ATMOSPHERE FOR THERMAL RADIATION FROM NUCLEAR WEAPONS
Mathew G. Gibbons 12 Aug. 1966 47 p refs
(USNRDL-TR-1060; AD-641481) CFSTI: HC $3.00/MF $0.65

The transmissivity of the atmosphere is estimated for thermal radiation from a nuclear weapon of any given yield and height of burst under various atmospheric conditions. Situations in which the effective source height (for thermal radiation) is less than one-quarter mile, the atmosphere is unclouded and the surface of the earth (or its covering) is of low albedo are considered first. The transmissivity for these situations is given in terms of a formula derived from earlier experiments of the author. Situations in which the effective source height (for thermal radiation) is equal to or greater than one-quarter mile are then considered, and basic transmissivity values are given in terms of effective fireball height and zenith angle for the case of an unclouded atmosphere, a visibility of about 12 miles and a low surface albedo. Factors are then given for modifying the basic transmissivity values to apply to other situations, such as ones with cloud cover or haze, and for taking into account high surface albedo. The factors for taking account of a cloud layer above the fireball and/or a high surface albedo are found to apply also to situations in which the effective fireball height is less than one-quarter mile.
Author (TAB)

N67-17156# Boston Univ., Mass. Physics–Astronomy Dept.
A NEW METHOD TO MEASURE ELECTRON COLLISION FREQUENCIES IN THE IONOSPHERE BY MEANS OF THE FARADAY ROTATION PROCESS
Michael D. Papagiannis Aug. 1966 18 p refs
(Contract AF 19(628)-2350)
(SR-4; AFCRL-66-618; AD-641896) CFSTI: HC $3.00/MF $0.65

A linearly polarized wave propagating in a quasi-longitudinal direction, will become elliptically polarized and show Faraday rotation after passing through an absorbing magnetoionic medium. The theoretical analysis of the problem has yielded a simple expression which relates the collision frequency of the transversed medium to the Faraday rotation and the axial ratio of the received elliptically polarized waves. Thus by means of the derived equations, one can determine the collision frequency by measuring the axial ratio and the Faraday rotation of the transmitted signals. This new method can be used in experiments with sounding rockets to obtain altitude profiles of the collision frequency in the lower ionosphere. It can also be used in satellite to ground experiments to determine the total absorption along the ray path. The applicability of the proposed new method in rocket and satellite experiments is demonstrated in the present report by means of numerical calculations with typical ionospheric profiles and appropriate transmitting frequencies.
Author (TAB)

N67-17311# Weapons Research Establishment, Salisbury (Australia).
UPPER ATMOSPHERE TURBULENCE—A REVIEW
R. J. Curnow May 1966 35 p refs
(WRE-PAD-118) CFSTI: HC $3.00/MF $0.65

A summary is made of the two main mathematical theories of turbulence and the consequences of these theories for the upper atmosphere outlined. An attempt is made to relate the theory and its consequences to the experimental results obtained from radio tracking of meteors and rocket techniques in the upper atmosphere. Estimates of the turbulence parameters are given for the height range 81–100 km.
Author

N67-17312# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PHYSICAL SCIENCES. VOLUME I: ATMOSPHERIC SCIENCES
D. W. Pearce and J. K. Green, ed. May 1966 51 p refs
(Contract AT(45-1)-1830)
(BNWL-235-1) CFSTI: HC $3.00/MF $0.65

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N67-17313# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PRECIPITATION SCAVENGING STUDIES
R. J. Engelmann and D. I. Hagen *In its* Phys. Sci., Vol. I May 1966 p 1–7 refs (See N67-17312 07-13) CFSTI: HC $3.00/MF $0.65

Washout coefficients for inorganic iodides present in process stack gases were measured in three snowfalls. The values of 4.1×10^{-5}, and 1.1×10^{-4} sec^{-1} were measured in columnar-crystal, snowfall rates of 0.4, 0.42, and 1.0 mm/hr, respectively. This indicates a linear relation to snowfall rate. In another test, in rainfall, organic iodides were scavenged with only about 1% of the inorganic iodides.
Author

N67-17314# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MIDAS COMPUTER PROGRAM FOR EVAPORATION OF FALLING DROPS
R. J. Engelmann *In its* Phys. Sci., Vol. I May 1966 p 7-8 ref (See N67-17312 07-13) CFSTI: HC $3.00/MF $0.65

A MIDAS (Modified Integral Digital Analog Simulator) computer program was prepared for use in the evaluation of evaporative losses of falling raindrops. The program gives as a function of time the drop diameter, temperature, vapor pressure, height, fall velocity, and horizontal drift distance for the input wind

speed, temperature, and humidity profile. A graph of the height-drift distance calculated for a small droplet is shown. A.G.O.

N67-17315# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

MIDAS COMPUTER PROGRAM FOR ISENTROPIC STREAM FUNCTIONS AND TRAJECTORIES

R. J. Engelmann and W. E. Davis *In its* Phys. Sci., Vol. I May 1966 p 8–9 (See N67-17312 07-13) CFSTI: HC $3.00/MF $0.65

A MIDAS (Modified Integral Digital Analog Simulator) computer program was developed to calculate the stream functions needed for long range trajectory construction on constant entropy surfaces. Three trajectories were constructed to check the program and technique, and it is reported that these compared favorably to constant altitude trajectories for the same dates. A.G.O.

N67-17319# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

SPECTRAL DISTRIBUTION OF ATMOSPHERIC TURBULENCE

C. E. Elderkin *In its* Phys. Sci., Vol. I May 1966 p 21–33 refs (See N67-17312 07-13) CFSTI: HC $3.00/MF $0.65

Measurements are presented of the turbulent fluctuations of wind components at various heights and for a number of wind speed and stability conditions. The vertical and longitudinal component power spectra have been analyzed and are shown in graphical form. The similarity of the spectral distributions, dependent on wave number and height, is demonstrated, and deviations from similar behavior as a result of stability effects are also noted. A.G.O.

N67-17332# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 355

19 Dec. 1966 38 p refs Transl. into ENGLISH from Chinese (JPRS-39173; TT-66-35596) CFSTI: $3.00

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3. PHASE FOCUSING THEORY OF KLYSTRON C.-l. Hsieh and Y.-h. Chao p 17–25 (See N67-17335 07-10)

4. THE POSSIBILITY OF EXPLAINING THE F_2 LAYER ANOMALY WITH THE DRIFTING THEORY C.-h. Li p 26–31 refs (See N67-17336 07-13)

N67-17333# Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF ADJUSTMENT IN ATMOSPHERIC MOTION

Tu-Cheng Yeh and Mai-Ts'un Li *In its* Transl. on Communist China's Sci. and Technol., No. 355 19 Dec. 1966 p 1–8 Transl. into ENGLISH from the book "Ta-Ch'i Yun-Tung Chung Ti Shih-Ying Wen-Ti" Peking, Sci. Publishing House, May 1965 p i–viii (See N67-17332 07-13) CFSTI: $3.00

This book discusses basic wave motions and energy transfer in the atmosphere. The general properties of the adjustment process and the change process and the physical properties of rotational adjustment are investigated. After a discussion of the adjustment process of normal pressure atmosphere, the rotational adjustment process of an eccentric atmosphere, and the adjustment problem of wind field and pressure field in the medium and small scale motions is analyzed. Author

N67-17334# Joint Publications Research Service, Washington, D. C.

COLLECTED RESEARCH REPORTS ON EARTHQUAKE ENGINEERING, VOLUME I

Hui-Hsien Liu, ed. et al *In its* Transl. on Communist China's Sci. and Technol., No. 355 19 Dec. 1966 p 9–16 Transl. into ENGLISH from the book "Ti-Chen Kung-Ch'eng Yen-Chiu Pao-Kao Chi" Peking, Sci. Publishing House, Sep. 1962 p i–iii, v, 1–2 (See N67-17332 07-13) CFSTI: $3.00

This book includes 13 reports on earthquake engineering: the first part concerns the problem of the theory of seismic force, with an emphasis on the criticism and supplementation of the statistical theory of seismic force; the second part concerns the problem of earthquake resistance in industrial and civil construction, with an emphasis on the self-vibration characteristic of structures and the method of measurement; the third part concerns the problem of earthquake resistance of hydraulic structures, with the application of the dynamic analyses method, which has been proven effective in industrial and civil construction. Author

N67-17336# Joint Publications Research Service, Washington, D. C.

THE POSSIBILITY OF EXPLAINING THE F_2 LAYER ANOMALY WITH THE DRIFTING THEORY

Ch'i-Hai Li *In its* Transl. on Communist China's Sci. and Technol., No. 355 19 Dec. 1966 p 26–31 refs Transl. into ENGLISH from K'o-Hsueh T'ung-Pao (Peking), v. 17, no. 12, Jun. 1966 p 570–572 (See N67-17332 07-13) CFSTI: $3.00

The author proves mathematically that the drifting motion in the F_2 region is negligible and that the drifting theory for the F_2 layer anomaly is invalid. The drifting velocity is expressed in spherical coordinates under the assumption that the geomagnetic field is a dipole field and that the ionospheric layers change according to the equation of continuity. Velocity divergence calculations for the different types of drifting motion show that the tidal amplification factor needs to be at least 10^8 for the case where drifting is caused by a polarized field, and needs to be at least 10^4 for tidal wind induced drifting. Since the attachment coefficient β for the F_2 region is $\beta \approx 10^{-4}$ sec^{-1}, it is concluded that the drifting motion is not important. G.G.

N67-17381*# Geophysics Corp. of America, Bedford, Mass.

STUDIES OF ATMOSPHERIC STRUCTURE AND THE VARIABILITY OF THE EARTH'S ATMOSPHERE Final Report

R. A. Minzner Jun. 1966 94 p refs

(Contract NASw-1225)

(NASA-CR-81529; GCA-TR-66-14-N) CFSTI: HC $3.00/MF $0.65 CSCL 04A

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10. TEMPERATURE DETERMINATION OF PLANETARY ATMOSPHERES R. A. Minzner and G. O. Sauermann p 89–94 refs

N67-17382*# Geophysics Corp. of America, Bedford, Mass.
CRITICAL EXAMINATION OF EQUATIONS FOR ATMOSPHERIC NUMBER-DENSITY CALCULATIONS—COMPUTED VALUES COMPARED WITH OBSERVATIONS
R. A. Minzner Nov. 1965 *In its* Studies of Atmospheric Struct. and the Variability of the Earth's Atmosphere Jun. 1966 p 71–73 refs (See N67-17381 07-13)
(GCA-TR-65-27-N) CFSTI: HC $3.00/MF $0.65

Some previously published equations for computing particle number density as a function of altitude are shown to have functional limitations which lead to progressively erroneous results as the temperature gradient approaches some realistic non-zero value. Development of series expansions for these equations has eliminated the basic problem. Other number-density equations based on the same fundamental premises are somewhat simpler and are formulated in such a way so as to shift the functional difficulty to the region of zero temperature gradient. Appropriate series expansions of these equations eliminate the functional difficulty and result in expressions which are not only simple, but also converge with great rapidity, so that usable results are obtained from the first term of the series and two terms usually lead to five-significant figure accuracy. Helium number densities computed by means of such equations for temperature-altitude profiles of two widely differing model atmospheres are presented. A comparison of the computed values with observed data suggests a variation in the onset level of helium diffusive separation of as much as 20 kilometers. Author

N67-17420# Sandia Corp., Albuquerque, N. Mex.
MULTIPLE ROW CHARGE BLAST-WAVE OBSERVATIONS AT LONG RANGE Final Report
Jack W. Reed 8 Sep. 1966 28 p refs
(Contract AT(29-1)-789; Proj. Dugout)
(PNE-607F) CFSTI: HC $3.00/MF $0.65

Air-blast wave measurements were made at ranges from 4 km to 200 km from the Plowshare Dugout high-explosives cratering event at the Nevada Test Site. In the Dugout event, a row of five nitromethane spheres were arranged to create a maximum ditch. Thirteen microbarograph stations were operated to determine how much attenuation of the blast wave was caused by explosives burial. Results showed that distant wave amplitudes ranged from 0.11 to 0.49 times as large as would have propagated from one of the nitromethane spheres burst in free air. Rocket wind observations were made to allow sound-ray propagation calculations for comparison with observations. In general, propagations were stronger than this calculation predicted. Three smaller explosives were burst above ground and one was burst on the ground to check atmospheric propagation conditions and to calibrate Dugout waves. Records from identical above-ground bursts, fired in a 5-minute period, showed that blast amplitudes were repeatable only within a factor of 0.70 to 1.43. Author (NSA)

N67-17442# Arizona Univ., Tucson. Geochemical Section.
CORRELATION AND CHRONOLOGY OF ORE DEPOSITS AND VOLCANIC ROCKS Annual Progress Report
Paul E. Damon 1 Jul. 1966 159 p refs
(Contract AT(11-1)-689)
(COO-689-60) CFSTI: HC $3.00/MF $0.65

An attempt was made to relate research within the broad scope of the evolution of western North America during post-Turonian time. Developments in analysis of argon, potassium, rubidium, and strontium are discussed. Areal and topical studies were conducted on the Mesozoic rocks in the Sierrita Mountains, geochronology of the Dos Cabezas Mountains in Arizona, premid-Tertiary erosion surface, K–Ar dates for Cenozoic volcanic rocks, dating of Plio-Pleistocene volcanic rocks, Cenozoic–Mesozoic magnetic pulses, granites from Kabaing Batholithic Complex, Magok Area, Burma, and excess argon in minerals. Some trace research was conducted on the "Turkey Track" andesite chemical analysis. Papers and abstracts of papers on the individual topics are included as appendices. NSA

N67-17452# Los Alamos Scientific Lab., N. Mex.
RESEARCH ACTIVITIES OF THE A.E.C. AIRCRAFT [IN ATMOSPHERIC TESTING]
R. W. Peterson, D. H. Liebenberg, and J. E. Keith (Sandia Corp., Albuquerque, N. Mex.) [1966] 37 p refs Presented at the Symp. on Recent Advances in Cosmic Ray Res., Huntington Beach, Calif.
(Contract W-7405-ENG-36)
(LA-DC-7837; CONF-660445-1) CFSTI: HC $3.00/MF $0.65

For the purpose of maintaining the AEC's atmospheric testing capability, three Air Force C-135 aircraft have been assigned to the AEC on a long-term basis. While most of the hours flown by the aircraft are for the requirements of the readiness program, some flight time is available for research on a non-interference basis. The types of experiments which have been done with the aircraft can be divided into three main groups: solar eclipse research, comet studies, and cosmic-ray research. Information on these studies is given. NSA

N67-17482# Texas A&M Univ., College Station. Dept. of Oceanography.
THE CHEMISTRY AND ANALYSIS OF TRACE METALS IN SEA WATER Final Report
Donald W. Hood 31 Jan. 1966 163 p refs
(Contract AT(40-1)-2799)
(TID-23295) CFSTI: HC $3.00/MF $0.65

Four sections are included; separate abstracts were prepared for each. NSA

N67-17640# National Center for Atmospheric Research, Boulder, Colo.
AN AIRPLANE-MOUNTED SYSTEM FOR SENSING AND RECORDING RADIO NOISE IN THE CLOUDS
J. Doyne Sartor and Paul A. Eden Mar. 1966 51 p
(NCAR-TN-7; PB-169874) CFSTI: HC $3.00/MF $0.65

Receivers, sensors, and recording system; flight procedures; and calibration of electric field probes are discussed for airborne instrumentation and procedures designed to detect and record radio noises from clouds. Since these emissions indicate some sort of electrification process within the cloud, they could be used to determine indirectly the state of cloud growth as well as the electrification growth within the cloud. Data for the aircraft antenna-receiver-recorder calibration permit the conversion of recorded radio noise to field strength voltages at five measurement frequencies recorded. Inaccuracies in the system are considered; and it is concluded that the calibration has resulted in fairly strict keeping of the aspect of the aircraft and antenna constant with respect to the cloud, and the resultant butterfly pattern. M.W.R.

N67-17643# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PERCUSSIVE (SHOCK) COMPRESSION OF QUARTZ
G. A. Adadurov, A. N. Dremin, S. V. Pershin, V. N. Rodionov, and Yu. N. Rysbinin 7 Dec. 1966 21 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, 1962 p 81–89
(FTD-HT-66-211; TT-67-60184; AD-643698) CFSTI: HC $3.00/MF $0.65

There is a large amount of silica in the earth's crust, which appears to be the main rock-forming material. Due to the fact that the high compressibility of silica at various depths may influence phenomena taking place underground (high polymorphic

conversions), the study of silica conversion involving dense forms at a high temperature and pressure was made. In 1953, a crystalline form of silica--coesite with a density of 3.01 g/cu cm was discovered, obtained by a static pressure of 35,000 kgm at temperatures from 500-800C. Coesite was found to come directly from quartz without using mineralizers; it was found in three large meteorite craters with a probable percussive origin. There arose the necessity to prove that coesite is formed in a very short action time under high pressure and temperature. Quartz crystals were cut at various angles and subjected to different types of compression shock waves. Screens of aluminum and iron were prepared to measure the shock waves. The waves were created by reflecting various detonation waves from the screens and by percussion of aluminum and iron flakes accelerated by explosion products. Samples with a width to height ratio of more than three were used in all experiments. Time intervals were taken by an electrocontact method and four oscillograms. Many equations are given with the application of the Hook Law. One of the conclusions is that displacing stresses within the body can be disregarded in comparison to normal stresses. Here the material is investigated as a liquid. An elastic and a plastic wave are produced, which react a certain way and then act as one. Author (TAB)

N67-17653# Utah State Univ., Logan. Electro-Dynamics Labs.
TECHNIQUES FOR THE MEASUREMENT OF AIRGLOW AND AURORA IN THE INFRARED
E. Ray Huppi 1 Jul. 1966 36 p refs
(Contract AF 19(628)-251)
(AFCRL-66-668; SR-5; AD-643911) CFSTI: HC $3.00/MF $0.65

Two systems designed to enable the spectral measurement of the airglow in the 2 to 4 micron region have been developed. Both systems are designed for use in high-altitude aircraft. This eliminates the problem of strong thermal emission of the lower atmosphere which is encountered when making airglow measurements in the 2 to 4 micron region from the ground. In the first system the entire measurement apparatus, including the interferometer-spectrometer, is cooled in order to eliminate unwanted thermal emission. The second system incorporates the use of a cold chopper mounted outside the aircraft. This technique allows the interferometer-spectrometer to be maintained at normal temperatures. TAB

N67-17706# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
GRAVITATIONAL DEVELOPMENT OF SLOPES [O GRAVITATSIONNOM RAZITII SKLONOW]
A. M. Trofimov Oct. 1966 6 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Aaved., Geol. i Razvedka (Moscow), v. 9, no. 7, 1966 p 30–31
(ACIC-TC-1129; TT-66-62584; AD-641756) CFSTI: HC $3.00/MF $0.65

Equations are derived for computing the morphometric characteristics of slopes. TAB

N67-17714# RAND Corp., Santa Monica, Calif.
SHORT-PERIOD PROPAGATION OF INFRASONIC WAVES FROM NUCLEAR EXPLOSIONS
W. C. Meecham Oct. 1966 30 p refs
(Contract ARPA SD-79; ARPA Order 189-1)
(RM-5103-ARPA; AD-643536) CFSTI: HC $3.00/MF $0.65

A possible explanation is given for the great time duration of intermediate-period (about one minute) and short-period (less than one minute) acoustic-gravity waves received from nuclear explosions. It is suggested that the signal delay for intermediate periods may be due to refraction from large-scale weather fronts, and that the signal delay for short periods may be caused by commonly occurring wind ducts. Author (TAB)

N67-17742# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SURVEY ON EARTH ALBEDO
Laird P. Whitehill 11 Oct. 1966 99 p refs
(Contract AF 19(628)-5167)
(TN-1966-53; ESD-TR-66-455; AD-643649) CFSTI: HC $3.00/MF $0.65

The paper is a study of the conditions that can be expected for the intensity of light reflected and scattered from the earth. The albedo of the earth is defined and the albedo of various surfaces, and regions of the earth are discussed. An attempt is made to survey typical results of measurements of Tiros data. The albedo of the earth covered by a Rayleigh atmosphere is presented in graphical form and the intensity distribution over the earth is plotted for various orientations of observer viewed spot and sun. A calculation of expected minimum response is made for a specific photodiode for a certain geometry and a method is presented to enable interested persons to easily perform similar calculations for different geometries. Author (TAB)

N67-17768*# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
MODIFICATIONS TO THE THEORY OF THE DIFFERENTIAL ABSORPTION EXPERIMENT
Alan H. Manson [1964] 18 p Submitted for Publication
(Grant NsG-467)
(NASA-CR-70253) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The method of using electromagnetic waves of medium frequency, which are partially reflected from irregularities in the mesosphere, to measure electron densities is considered. A modification is proposed which involves the Fresnel reflection coefficient of the irregularities. The most plausible explanation for these irregularities is described in terms of internal atmospheric gravity waves. This theory suggests that the partial reflections from 60–75 km were due to irregularities that were caused directly by these gravity waves, and that above 80 km reflections were due to turbulence caused by the waves. S.P.

N67-17776*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THEORETICAL MODEL FOR THE MAGNETIC DECLINATION EFFECT IN THE IONOSPHERIC F REGION
Richard A. Goldberg Jun. 1966 24 p refs
(NASA-TM-X-55612; X-615-66-258) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Studies of foF2 have indicated that magnetic declination influences the behavior of the F region ionosphere, and furthermore that this effect is not limited to low latitudes. It has been demonstrated that the geomagnetic anomaly distribution can be described in terms of a non-accelerating electron density distribution under the influence of electric, magnetic and gravitational forces and the effects of production and loss. It is suggested that these individual magnetically aligned planes of ionization can be correlated by a longitudinal density distribution as a boundary condition, this distribution being geographically oriented because its variations are primarily under solar control. This concept is introduced into the equations by means of a current system, necessary to create a balance of forces under equilibrium conditions. The intermixing of a geographically controlled longitudinal distribution with a geomagnetically controlled latitudinal distribution is then found to provide a consistent picture of the declination effects previously reported in the literature. Furthermore, it enables shapes and behavior of the distribution, heretofore unstudied, to be predicted. Author

N67-17806 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
DIFFERENTIAL DOPPLER SYSTEM FOR MAGNETOSPHERIC AND INTERPLANETARY ELECTRON DENSITY MEASUREMENTS [DIFFERENTIELLES DOPPLERVERFAHREN FUER MAGNETOSPHAERISCHE UND INTERPLANETARE ELEKTRONENDICHTE-MESSUNGEN]
H. H. Rabben Jun. 1966 34 p refs In GERMAN
(MPI-PAE-Extraterr.-31/66)

Following the successful ionospheric electron density measurements by Seddon (1953) using the differential Doppler system the suitability of this relatively simple technical process is discussed for both the magnetosphere and the interplanetary medium. This process is compared with the proposed wave propagation method for direct determination of the plasma frequency. The choice of method depends on the marginal conditions of the measurements. Author (ESRO)

N67-17812# Centro di Studio per la Fisica delle Microonde, Florence (Italy).
THE MEASUREMENTS OF ELECTRON TEMPERATURE IN THE IONOSPHERE AND THE ERROR INTRODUCED BY THE USE OF GRIDS FOR LANGMUIR ANALYSIS [LE MISURE DI TEMPERATURA ELETTRONICA NELLA IONOSFERA E L'ERRORE INTRODOTTO DALL'IMPIEGO DI GRIGLIE PER L'ANALISI ALLA LANGMUIR]
P. Bruscaglioni Apr. 1966 28 p refs In ITALIAN; ENGLISH summary Prepared Jointly with Consiglio Nazionale Delle Ricerche
(CM-R33-10.3) CFSTI: HC $3.00/MF $0.65

An analysis is made of the error introduced by the non homogeneity of electrostatic potential on the plane of the probe described in CM-R27-10.1 (See N66-00000 00-10), when Langmuir analysis is made. It is shown that the error can be maintained small, by means of a careful choice of the grid structure. Author (ESRO)

N67-17820# Institut d'Aeronomie Spatiale de Belgique, Brussels.
SHOCK WAVE FROM A RELEASE OF GAS AT 230 KM ALTITUDE
M. Ackerman, G. Kockarts, and R. Pastiels 1966 10 p refs Submitted for Publication *Its* Aeronomica Acta No. 51, 1966
CFSTI: HC $3.00/MF $0.65

Photographic measurements of the velocity of a shock wave observed during an ESRO (European Space Research Organization) rocket experiment lead to a temperature determination of 743°K at 230 km altitude. Author (ESRO)

N67-17841# European Space Research Lab., Noordwijk (Netherlands).
NEUTRAL PARTICLE COMPOSITION OF THE UPPER ATMOSPHERE
R. Jaeschke Paris, ESRO, Dec. 1965 15 p refs
(ESRO-SN-21) CFSTI: HC $3.00/MF $0.65

Neutral particle composition of the atmosphere will be measured above 110 km altitude by a mass spectrometer mounted in a Centaur rocket nose cone. Neutral atoms entering the apparatus are first ionized then analyzed by a quadrupole mass filter capable of separating mass numbers 1 to 50. Night- and day-time conditions will be compared by launching two identical payloads from the same range ten hours apart. Author (ESRO)

N67-17859# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
RESEARCH IN SEISMOLOGY Annual Report, 1 Nov. 1965–31 Oct. 1966
Frank Press and M. Nafi Toksoz 31 Oct. 1966 43 p refs
(Contract AF 49(638)-1632; ARPA Order 296-66; Proj. Vela-Uniform)
(AFOSR-67-0178; AD-643966) CFSTI: HC $3.00/MF $0.65

The velocity structure in the earth's mantle is determined using the travel times and travel-time slopes of P-waves recorded at LASA. The results show anomalous velocity gradients at depths of 700, 1200, and 1900 km. Both surface wave dispersion data and dt/d delta data show the presence of lateral heterogeneities in the upper and lower mantle. Theoretical studies of acoustic and gravity wave propagation in the atmosphere-ocean systems, affected of aftershocks on free oscillations, and response of layered spherical earth to point sources have been described. Author (TAB)

N67-17947*# Volt Technical Corp., Washington, D. C.
CONCERNING ONE NOTION ABOUT THE ANOMALOUS GRAVITATIONAL FIELD
A. A. Mikhaylov 22 Dec. 1966 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 4, 1966 p 828–830
(Contract NAS5-12487)
(NASA-CR-81676; ST-CM-10548) CFSTI: HC $3.00/MF $0.65 CSCL 08N

A theoretical study on the Earth's anomalous gravitational field is reported. To avoid complex calculations, it is proposed that the Earth's anomalous gravitational field be represented by several values of anomalies on the sphere such that the perturbing potential is determined only by these values. It is concluded that the main difficulties in theoretical studies of the Earth's shape arise when determining the surface of the normal Earth and the limit values of the perturbing potential. It is surmised that the problem of determining the geoid's shape may be considered as a boundary value problem only in the first approximation. S.C.W.

N67-17988*# Florida State Univ., Tallahassee. Dept. of Meteorology.
ACOUSTIC-GRAVITY WAVES IN THE EARTH'S ATMOSPHERE. I: THE GENERAL NATURE OF ACOUSTIC-GRAVITY WAVES.
John C. Gille Dec. 1966 79 p refs Lectures in the NATO Advanced Study Inst. on Movements and Turbulence of the Atmosphere Between 30 and 120 km. held at Lindau, W. Germany, 19–30 Sep. 1966
(Grants NsG-173; NSF GP-2371; Contract Nonr-266(70))
(NASA-CR-81657; TN-66-7) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Two lectures are presented which review the present state of understanding of the acoustic and internal gravity waves in the earth's atmosphere. The first concerns the nature, propagation, and ducting of infrasonic waves in the terrestrial atmosphere and attempts to present the basic mathematics and physics upon which results are based, to explain the processes involved, and to discuss qualitatively the results of numerical calculations. The second discusses atmospheric acoustic and gravity wave ducting by vertical temperature structure. R.N.A.

N67-18059# Atomic Weapons Research Establishment, Aldermaston (England).
ABSORPTION OF ELASTIC WAVES—AN OPERATOR FOR A CONSTANT Q MECHANISM
E. W. Carpenter Oct. 1966 19 p refs
(AWRE-O-43/66) HMSO: 2s 6d

Theoretical analysis is given of absorption of elastic waves in the frequency range of seismological interest. The impulse response of a system satisfying the constant Q hypothesis is calculated and the results discussed. Author

N67-18080# Centre de Recherches et d'Essais de Chatou (France).
BED-MATERIAL TRANSPORT STUDY BY TRACERS [ETUDE DU CHARRIAGE D'UN ECOULEMENT PAR TRACEURS RADIOACTIFS]
J. Danion Brussels, EURATOM, Oct. 1966 74 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-019-62-12 IRAF)
(EUR-3130.f, Vol. I) CFSTI: HC$3.00/MF$0.65

Two series of in-channel laboratory tests were conducted for the purpose of a special study of the so-called centre-of-gravity method of determining bed-material transport in a waterway. The flow conditions were so chosen as to produce transport with dunes and without saltation, specially treated polystyrene granules being used as bed-material. The surface labelling of this material with Au-198 in no way affected the dynamic behavior of the granules. The movement of the tracer was observed at regular intervals by means of a scintillation probe travelling at constant speed above the water surface in the channel axis. The average speed of the tracer cloud can be accurately measured, but determination of the average transport thickness to be taken into account in the calculation of the bed load is still awkward and inaccurate. Various methods of determining this parameter are described and the results compared with reference to several series of tests. Author

N67-18070# Atomic Weapons Research Establishment, Aldermaston (England).
SOME SEISMIC RESULTS OF THE LONG SHOT EXPLOSION
P. D. Marshall, E. W. Carpenter, A. Douglas, and J. B. Young Oct. 1966 18 p refs
(AWRE-O-67/66) HMSO: 2s 6d

LONG SHOT, with a predicted yield of 80 kton, was detonated underground on Amchitka Island in the Aleutians and recorded at Eskdalemuir, Yellowknife (Canada), Gauribidanur (India) and Tennant Creek (Australia). The results of processing of the array records are presented, and compared with the results from many other stations. The location of the epicentre is also discussed. Author

N67-18115# Joint Publications Research Service, Washington, D. C.
OBSERVATIONS OF ULTRALOW FREQUENCY RADIATION AT TWO CONJUGATE POINTS
N. G. Kleymenova, V. A. Troitskaya, R. Zhandren, K. Ponse, and Zh. Vineron 9 Jan. 1967 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 4, 1966 p 835–836
(JPRS-39458; TT-67-30108)

Simultaneous observations of natural ultralow frequency (ULF) radiation are reported for the magnetically conjugate points of Sogra, USSR, and Kerguelen, a French Island in the Indian Ocean. Properties and diurnal variations differ for hissing and chorus ULF emissions. Even though the choruses do not appear at the two stations simultaneously, spectral analysis reveals the fine structure of all choruses to be the same. The form and amplitude of the hissing bursts are shown to be the same for both stations. It is concluded that the 11 choruses observed simultaneously at the conjugate stations are precursors of negative ionospheric storms; but nine positive ionospheric storms that exhibited critical increases in critical frequency of the F2 layer of between 30 and 45% were never accompanied by either choruses or hissing. Choruses heard at only one of the stations usually preceded a decrease of critical frequency by 8 to 15%. Absence of ULF radiations is noted in magnetically quiet periods. M.W.R.

N67-18116 Joint Publications Research Service, Washington, D. C.
ON DETERMINING THE DEPTH OF THE ZERO SURFACE
V. F. Kozlov 9 Jan. 1967 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 5, 1966 p 1068–1069
(JPRS-39457; TT-67-30107)

A method is proposed for determining the depth of the zero surface, the surface at which the horizontal components of velocity disappear in the oceans. Equations of geostrophic movement in a nonhomogeneous ocean are written, and the conditions are given for the existence of zero surface during geostrophic movements. Dependence of conditional density at the zero surface on depth is graphed. M.W.R.

N67-18132*# Arizona Univ., Tucson. Lab. of Tree-Ring Research.
AN EVALUATION OF POSSIBLE RELATIONSHIPS BETWEEN SOLAR ACTIVITY AND TREE-RING GROWTH IN WESTERN NORTH AMERICA Semiannual Report
Harold C. Fritts Jan. 1967 6 p
(Grant NGR-03-002-101)
(NASA-CR-81788) CFSTI: HC$3.00/MF$0.65 CSCL 04A

Continuing research in various phases of a study on possible relationships between solar activity and tree-ring growth in western North America is reported, including a program for pre-whitening tree-ring series, processing of long-term chronologies, tests of normality and stationarity, and probes for tree-ring, solar, and climatic relationships. Preliminary results of the following analyses are reviewed: power and cross-power spectra; first differences and serial correlation; and filtering of chronologies with a low pass, a high pass, and an 11-yr band pass numerical filter and correlation with a similarly filtered sunspot series. L.E.W.

N67-18140*# Houston Univ., Tex. Dept. of Chemistry.
ALIPHATIC HYDROCARBONS IN PRECAMBRIAN ROCKS
J. Oro' and D. W. Nooner [1967] 34 p refs Submitted for Publication
(Grants NsG-257; NGR-44-005-020)
(NASA-CR-81776) CFSTI: HC$3.00/MF$0.65 CSCL 08D

To obtain additional data on Fig Tree Precambrian sediments, gas chromatograph-mass spectrometer combination analysis of saturated isoprenoid hydrocarbons extracted in Houston are reported during this period. The chromatographic pattern of the paraffinic hydrocarbons recovered is depicted. It was concluded that because of the compact nature of some of the rock samples, especially the chert, and the fact that internal samples were analyzed in most cases, it is probably that the hydrocarbons are indigenous to the rock. R.Li.

N67-18174# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA, SEPTEMBER 1964
Sep. 1964 74 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res.
(RRC-A112) CFSTI: HC$3.00/MF$0.65

Ionospheric and radio propagation data collected in India during September, November, and December, 1964, and also during February, June, and July, 1965, are presented. Tables represent observations from nine stations, eight of which are in the 75°E longitude zone, covering a range of geometric latitudes from 19.2°N to 0.9°S. Supplementary geophysical data of interest are included. G.G.

N67-18175 National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA, NOVEMBER 1964
Nov. 1964 75 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res. for Abstract see N67-18174 07-13
(RRC-A114) CFSTI: $3.00

N67-18176# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA, DECEMBER 1964
Dec. 1964 76 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res. For Abstract see N67-18174 07-13
(RRC-A115) CFSTI: $3.00/MF$0.65

N67-18177 National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA, FEBRUARY 1965
Feb. 1965 75 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res. For Abstract see N67-18174 07-13
(RRC-A117) CFSTI: $3.00

N67-18179# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA, JULY 1965
Jul. 1965 76 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res. For Abstract see N67-18174 07-13
(RRC-A122) CFSTI: HC $3.00/MF $0.65

N67-18178# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA, JUNE 1965
Jun. 1965 68 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res. For Abstract See N67-18174 07-13
(RRC-A121) CFSTI: HC $3.00/MF $0.65

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-16726*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF A SOLID-STATE IMAGE CONVERTER
Carl T. Huggins *In its* Commun. Systems Res. at MSFC 1966 p 9–12 (See N67-16724 07-07) CFSTI: HC $3.00/MF $0.65

A solid-state image converter equivalent to the vidicon and capable of imaging radiation from the near infrared to 11,000 Å is discussed. The image converter and its associated circuit comprise a very small solid-state television camera designed for space use. A monolithic mosaic of photo-transistor elements is complemented by densely packed integrated electronic circuits containing commutation switches, logic and switch-pulse generating circuits, and a video preamplifier (emitter follower amplifier). Author

N67-16816*# National Aeronautics and Space Administration, Washington, D. C.
USE OF INDICATOMETRY FOR VERIFYING THE HYPOTHESIS OF A LIMONITE SURFACE COVER ON MARS
T. D. Bessonova *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 91–94 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

A large indicatometer was used to study the reflection indicatrix for a number of dust-like materials which are close to the Martian albedo in color (loamy and powdered limonites, terra rossa, soils with high iron orthotropic, in contrast to light-colored materials, the indicatrix being stretched out toward the source of light (the smoothness factor q is less than unity) although the difference is not great. It is concluded that quite probably there may be a powdered limonite-colored cover on Mars. Author

N67-16819*# National Aeronautics and Space Administration, Washington, D. C.
INTENSITY MICROPHOTOMETER BASED ON THE MF-4
L. A. Bugayenko and K. Ye. Skorik *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 105–109 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

The authors describe an intensity microphotometer designed and built at the Main Astronomical Observatory of the Academy of Sciences, Ukrainian SSR. The input signal is converted by piecewise-linear diode approximators. Measurement error is less than 1%. The reading is stabilized against the background. Author

N67-16825# Polytechnic Inst. of Brooklyn, N. Y.
PLASMA LABORATORY
H. Farber *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 3–5 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Research and development of experimental set-ups for diagnostic purposes in a plasma laboratory are reported. Areas discussed include vacuum systems, consoles for several different plasma diagnostic measurement techniques, and apparatus for developing plasmas. C.T.C.

N67-16827# Polytechnic Inst. of Brooklyn, N. Y.
OPTICAL SPECTROSCOPIC DIAGNOSTICS—THE STUDY OF FUNDAMENTAL PROCESSES IN THE TOROIDAL DISCHARGE
R. J. L. Chimenti *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 21–23 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Modifications to a diagnostic facility for making time resolved spectroscopic studies of pulsed plasmas are discussed. These modifications include adaptation of slits to the frame of an existing monochromator, masking imperfections in a spherical mirror, and a development of a two speed drive to rotate the grating. It is noted that the resulting graph is the complete spectrum at one instant of time during the discharge. C.T.C.

N67-16847# Polytechnic Inst. of Brooklyn, N. Y.
TANDEL—A NONLINEAR DIELECTRIC DEVICE FOR ANALYSIS OF FLOWS OF BINARY GAS MIXTURES
K. R. Jolls, P. M. Sforza, and N. N. Trentacoste *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 194–196 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Progress in the development of a method for the measurement of composition and flow properties of binary gas mixtures is reported. This "onstream" technique utilizes a solid state transducer which is sensitive to heat transfer and which autostabilizes its operating temperature over a wide range of ambient conditions. Several large single crystals of triglycine sulphate were obtained, and means were acquired for the identification of the ferroelectric axis in a crystal. The design of a simple calibration unit which will be used to determine the response of the Tandel to variations in certain scalar properties of the ambient is mentioned. C.T.C.

N67-16905*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
MECHANISM FOR SPACECRAFT REFLECTANCE-DEGRADATION EXPERIMENT
E. Cornish, R. K. Kissinger, and G. P. McCabe *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 51–60 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65
(Contract AF 33(615)-1577)

An instrument has been designed to expose reflective surfaces to the sun for four months in space. Solutions to design problems include a magnetic drive unit to transmit motion from an enclosed motor to the outer mechanism, a light-integrating sphere using an electronically pulsed light beam for the detection of degradation of the samples, and electronic means for repositioning samples after readout. Author

N67-16909*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DRAG MAKE-UP SENSOR FOR LOW-ALTITUDE SATELLITES
William R. Davis *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 91–100 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

Characteristics of the satellite environment were exploited to simplify greatly the instrumentation needed to measure, and compensate for, satellite air-drag force. A photoelectric pickup is used to detect the position of an untethered ball that floats loosely in a cage within the vehicle. A thruster on the vehicle, controlled by a ball–cage position signal, keeps the cage (and vehicle) centered on the ball and thus in a drag-free trajectory. The ball is shielded from the air stream by the vehicle. Hardware for a flight test is described. Author

N67-16915*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NONMAGNETIC EXPLOSIVE-ACTUATED INDEXING DEVICE
John P. Bauernschub, Jr. *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 157–166 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

A nonmagnetic, explosive–actuated, indexing device was developed for a magnetometer experiment flown on the Pioneer VI Spacecraft. Conventional indexing devices were not suitable for use in instruments designed to measure low intensity magnetic fields. This device features an arrangement by which new explosive piston actuators are cycled into position to provide 11 independent operations. The pistons actuate a bistable escapement which permits precisely 180-deg rotation of the magnetometer sensor. Although the device was designed for a specific purpose, it is basically a nonmagnetic stepping motor. It can be modified for other stepping increments, and more operations can be provided. Author

N67-16924*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ANALYSIS OF A SATELLITE ANGLE-OF-ATTACK SENSOR
William E. Frye *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 277–284 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

The direction of the deceleration due to airdrag on an attitude-stabilized satellite is sensed by a simple pendulum immersed in a damping fluid. Consideration is given to the manner in which the device responds to perturbations caused by attitude oscillations, variations in air density, orbit eccentricity, gravity gradient, and internal instrumental perturbations. Restrictions on the location of the device relative to the center of mass of the vehicle and the choice of damping fluid are also discussed. Author

N67-16945# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Chemistry Research Lab.
A TANDEM MASS SPECTROMETER FOR THE STUDY OF ION-MOLECULE REACTIONS
Jean H. Futrell, Larry I. Bone, and Fred P. Abramson *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 25 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

An instrument for the study of ion molecule reactions has been developed that consists of a double-focusing mass spectrometer which serves as an ion source for a collision chamber connected to a second double-focusing mass spectrometer. The in-line configuration maximizes collection of momentum transfer products and ion beams of useful intensity are produced over an energy spread of 0.3 eV. Experimental results which exemplify this instrument's utility in identifying reaction partners are discussed. Examples are also given which demonstrate the value of this instrument for studying the kinetic effects of ion translational energy. Two general phenomena associated with ion translational energy are described. One is a change in mechanism with kinetic energy and the other is the conversion of translation energy into internal energy of the reaction complex. Author

N67-16956# Air Force Cambridge Research Labs., Bedford, Mass.
RAPID REMOTE AND SENSING BY SPECTRUM MATCHING TECHNIQUE. PART 2: APPLICATION IN THE LABORATORY AND IN LUNAR OBSERVATIONS
Graham R. Hunt, John W. Salisbury, and John W. Reed *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 29 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

A spectrum matching technique has been developed for rapid remote sensing of mid-infrared molecular vibration emission spectra of lunar and planetary surfaces. It is primarily useful when the remote sensing must be carried out in the presence of a variable intervening attenuator, which puts a premium on rapidity of measurement. A major advantage is achieved over conventional spectroscopic techniques when compositional differences and/or general compositional trends, rather than absolute composition, are the parameters to be measured. Laboratory tests of this technique with a simple spectrum matching instrument and with a more sophisticated x-y scanning instrument have demonstrated its feasibility. Use of the simple instrument on lunar targets has delineated very small, but consistent differences between different areas on the lunar surface. Among other things, these data indicate that the lunar surface materials possess a rough surface on a micron scale. Author

N67-16964# Air Force Flight Test Center, Edwards AFB, Calif. Flight Test Engineering Performance Engineering Branch.
THE USE OF FLIGHTPATH ACCELEROMETERS IN PERFORMANCE FLIGHT TESTING
Willie L. Allen and Robert H. Weight *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 21 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

The development of a useful Flightpath Accelerometer System has taken place over the past ten years. In present systems an extremely sensitive accelerometer is mounted in the nose boom of an aircraft and aligned to the flightpath through the use of an angle of attack vane. The resolution of the accelerometer is increased through the use of a Vernier range extender. By directly measuring acceleration along the flightpath, excess thrust can be calculated from Newton's second law of motion. These techniques are presently in use at the Air Force Flight Test Center to gather range, drag, climb and maneuverability data from flight tests. Future developments and applications are discussed. Author

N67-16966# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Mechanical Engineering.
THIN-FILM HEAT TRANSFER GAGES
John W. Frye, Jr. and Milton E. Franke *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 38 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

Methods and techniques for fabricating, calibrating, and using thin-film gauges are discussed. The gauges were fabricated using liquid platinum paint applied to a quartz backing material and were calibrated using the electrical pulse method. The wall surface temperature variation and rates of heat transfer were determined for a station on the wall of a shock tube for the laminar boundary layer flow condition immediately after shock wave passage for shock Mach numbers between 1.15 and 2.50. The results were correlated with theoretically predicted values and other published experimental data. Author

N67-16970# Photomapping Wing (MAC) (1370th), Turner AFB, Ga. 1381st Geodetic Survey Squadron.
DESIGN, FABRICATION AND TESTING OF A PROTOTYPE FLY-AWAY SATELLITE TRIANGULATION SYSTEM
Martin Selinfreund and George P. Musante *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 27 p (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

This paper discusses the background of the Air Force Geodetic Stellar Camera System and presents the details of the design and fabrication of a prototype fly-away Satellite Triangulation System. The development of a chopping shutter and accurate timing equipment is also discussed. Author

N67-16982# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.

PHOTOGRAPHIC DISPLAY SYSTEMS—TYPICAL USAF APPLICATIONS

Leon McDowell *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 29 p (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

This paper presents a comparative study of the rapid process photographic film equipments that are currently being used in United States Air Force Command and Control Systems, and includes a review of the technological and operational aspects of photographic film systems. The effectiveness of photographic techniques in providing the display capability in a command and control environment is discussed. Four functional areas of photographic recording and projection are discussed: (1) digital to image conversion, (2) camera optics, (3) film and processor, and (4) projection optics. Data are included in the form of a tabulated summary of pertinent performance parameters such as resolution, symbol brightness and contrast, symbol size, and stroke-width. Maintenance requirements and the annual operating cost of the systems under study are considered. Author

N67-16990# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.

USAF IMPROVED ALTIMETRY SYSTEMS

Philip R. Marshall *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1968] 34 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

This paper discusses the accuracy limits of altimetry systems being considered as requirements, the problems associated with the systems that must be resolved to meet the requirements, and results of various development and test efforts aimed at providing improved altimetry. Specific factors discussed are: (1) vertical separation criteria, (2) static pressure systems, (3) altitude computers, (4) servo-pneumatic altimeters, and (5) altimeter displays. Author

N67-17077# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

A NEUTRON COUNTER FOR ANALYTICAL APPLICATIONS

T. Richard Harold and H. Perry Holcomb Aug. 1966 18 p refs (Contract AT(07-2)-1) (DP-1035) CFSTI: HC $3.00/MF $0.65

A neutron counter was developed to assay rapidly and nondestructively such radionuclides as ^{244}Cm and ^{252}Cf by counting the spontaneous fission neutrons that these isotopes emit. Neutrons are thermalized in a polyethylene moderator assembly and counted with BF_3 detectors spaced in the moderator. The counter background is 4 counts/minute and the counting efficiency is 4%. The reliable detection limit is 4×10^{-7} g for ^{244}Cm and 1.2×10^{-12} g for ^{252}Cf. Author (NSA)

N67-17078# Atomic Energy Commission, New York. Health and Safety Lab.

POINT SOURCE DETECTION BY SCINTILLATION SURVEY METER

Robert T. Graveson Jul. 1966 38 p refs (HASL-177) CFSTI: HC $3.00/MF $0.65

While the scintillation survey meter displays high sensitivity to gamma radiation, its ability to locate small sources is limited. The parameters controlling detected radioactive count rate such as detector size, quantum efficiency, and the effect of pulse height discrimination have been explored with respect to sodium iodide phosphors. The analysis of the statistical variability of ratemeter readings is related to the minimum increase in count rate necessary for reliable detection. Also, the effect of relative motion between the source and the survey meter as it affects detection sensitivity has been related to ratemeter response time. Empirical as well as rigorous relationships are derived and used to accurately predict the performance of several sizes of scintillation detectors. Author (NSA)

N67-17096# IIT Research Inst., Chicago, Ill. Technology Center.

CONTINUOUS FACSIMILE SCANNER EMPLOYING FIBER OPTICS Quarterly Report, 1 Jul.–30 Sep. 1965

Donald A. Pontarelli May 1966 18 p (Contract DA-28-043-AMC-00164(E)) (IITRI-A6093-15; QR-5; AD-642675) CFSTI: HC $3.00/MF $0.65

The major achievements of the period covered by this report were: (1) Reduction by several orders of magnitude of the defects occurring at the core-coating interface of fibers. (2) Production of a photographic record essentially free of photometric imperfections by means of a 2.5 inch fiber optics facsimile scanner. (3) Identification of grinding and polishing as a phase which requires further detailed study. (4) Accumulation and cataloging of characteristic photodetector data. Author (TAB)

N67-17161# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW TECHNIQUES IN ASTRONOMY. MATERIALS OF THE 1961 CONFERENCE Selected Articles

13 Apr. 1966 69 p refs Transl. into ENGLISH from the book "Novaya Tekhnika v Astronomii. Materialy Soveshchaniya 1961" Moscow, Izd. AN SSSR, 1963 p 13–16, 60–79, 91–97, 111–117 (FTD-TT-66-38; TT-66-62565; AD-641650) CFSTI: HC $3.00/MF $0.65

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3. PHOTOGRAPHIC METHODS FOR STUDYING THE ERRATIC NATURE OF STELLAR IMAGES I. P. Rozhnova and Yu. A. Sabinin p 39–49 refs (See N67-17164 07-14)

4. CAMERA WITH OPTICAL COMPENSATOR FOR OBSERVING ARTIFICIAL EARTH SATELLITES Kh. I. Potter and Yu. S. Streletskiy p 50–61 refs (See N67-17165 07-14)

N67-17162# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONTROL SYSTEM FOR THE 2.6-METER TELESCOPE

N. S. Zhurkin, V. M. Konshin, and G. L. Gruk *In its* New Tech. in Astronomy 13 Apr. 1966 p 1–7 (See N67-17161 07-14) CFSTI: HC $3.00/MF $0.65

Problems connected with the maximum automatization of the telescope control are discussed, and the basic devices incorporated into the system are described. A central control panel (CCP) provides automatic and semiautomatic placement of the reflector with respect to given coordinates. The CCP also controls the photoguide operation, main reflector cover mechanisms, guide covers, and the Cassette section mechanisms of the main focus and the prime focus glass. A computer analyzer calculates the composite corrections for average refraction and flexure of the tube and telescope mounting with respect to hour angle and declination; converts equatorial coordinates into azimuthal coordinates; and generates the position angle necessary for adapter motion. A stable frequency generator assures diurnal drive of the telescope in regard to hour angle when observing stars, and drive of the telescope by means of a lunar planet drive mechanism when observing planets and the moon. An auxiliary panel gathers semiautomatic control elements of all the cupola mechanisms. M.G.J.

N67-17163# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PRINCIPLES OF CONSTRUCTION OF DISCRETE SYSTEMS OF CONTROL FOR AZIMUTHAL ASTRONOMICAL INSTRUMENTS

S. V. Korotkov, V. A. Myasnikov, and Yu. A. Sabinin *In its* New Tech. in Astronomy 13 Apr. 1966 p 8–38 refs (See N67-17161 07-14) CFSTI: HC $3.00/MF $0.65

Operational peculiarities of instruments on an azimuthal mounting are examined, and the basic technical requirements placed on a control system for such instruments are discussed. Formulas connecting the equatorial and azimuthal coordinates are considered as a basis for selecting the necessary algorithms. A structural digital tracking system (DTS) scheme is selected and analyzed based on an analogy with systems of continuous operation. It is pointed out that a digital differential analyzer may be used for solving trigonometric dependencies in discrete form. Basic information theory concepts are employed to calculate the parameters of a digital guiding system. A method is developed for reducing the iteration frequency and frequency of comparison realized by introducing a rate control system; this makes it possible to significantly approach a zero velocity assuring a sufficiently wide control range. M.G.J.

N67-17164# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHOTOGRAPHIC METHOD FOR STUDYING THE ERRATIC NATURE OF STELLAR IMAGES

I. P. Rozhnova and Yu. A. Sabinin *In its* New Tech. in Astronomy 13 Apr. 1966 p 39–49 refs (See N67-17161 07-14) CFSTI: HC $3.00/MF $0.65

Details are given on a photoelectronic method of studying stellar images, which were developed to create a more objective technique of examining star vibrations for narrow targets and automation requirements. Essentially, the star image is formed on the apex of a tetrahedral pyramid, oriented so that the axes of its base coincide with the t and δ axes of the telescope. The apex must have a truncation of not more than 5×5 microns. Four photomultipliers are used in the installation, each of which is placed opposite the corresponding face of the pyramid. Photomultipliers situated on opposite sides are coupled in pairs to a differential circuit; signals from the load registers are fed to preamplifiers with an amplification factor of 10^3. The signal is then directed to the input of a balance amplifier. If the star is located precisely on the optical axis then an identical light flux is reflected from each side of the pyramid; in this case the stream is balanced. With the slightest deviation from the optical axis, a circuit imbalance occurs which is proportional to the magnitude of deviation. Schematic diagrams are included. M.G.J.

N67-17165# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CAMERA WITH OPTICAL COMPENSATOR FOR OBSERVING ARTIFICIAL EARTH SATELLITES

Kh. I. Potter and Yu. S. Streletskiy *In its* New Tech. in Astronomy 13 Apr. 1966 p 50–61 refs (See N67-17161 07-14) CFSTI: HC $3.00/MF $0.65

In the method described, a rotating planoparallel transparent glass filter, or satellite motion compensator, is placed in front of the focal plane of an astrograph with a focal length on the order of 2 to 2.5 m, and a corrected field of about 5°×5°. During the passage of the satellite across the field, the filter rotates around an axis perpendicular to the direction of satellite motion with an appropriate angular velocity. As a result, point images of the satellite are obtained on the photoplate as well as images of reference stars. The coordinates (α,δ) of the satellite may then be determined by ordinary methods of photographic astrometry. The action of the rotating filter is detailed. It is concluded that use of the optical compensator results in a significant gain in image brightness, and an increase in the effective penetrating power of the astrograph. M.G.J.

N67-17178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW TECHNIQUES IN ASTRONOMY. MATERIALS OF THE 1961 CONFERENCE Selected Articles

6 Apr. 1966 23 p refs Transl. into ENGLISH from the book "Novaya Tekhnika v Astronomii. Materialy.Soveshchaniya 1961" Moscow, Izd. AN SSSR, 1963 p 165–174

(FTD-TT-65-1537; TT-66-62517; AD-641106) CFSTI: HC $3.00/MF $0.65

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1. SPECTROGRAPHY WITH PHOTOCONTACT DEVICE TO OBSERVE FOGGINESS V. F. Yesipov p 1–11 refs (See N67-17179 07-14)

2. EXPERIENCE IN USING A VACUUM CHAMBER FOR TESTING ACCURATE MIRRORS OF ASTRONOMICAL INSTRUMENTS V. A. Savin p 12–18 (See N67-17180 07-11)

N67-17179# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPECTROGRAPH WITH PHOTOCONTACT DEVICE TO OBSERVE FOGGINESS

V. F. Yesipov *In its* New Tech. in Astronomy 6 Apr. 1966 p 1–11 refs (See N67-17178 07-14) CFSTI: HC $3.00/MF $0.65

Possible areas of applying electron-optical instruments in astronomical observations are examined, with attention focused on direct photography and astrospectroscopy. For direct photography, the use of highly sensitive electron-optical instruments is considered justified only in those cases where the background of the sky is not reached at any reasonable exposure. Astrospectroscopy appears to be the area in which such instruments can be effectively applied, particularly when photographing spectra in a close infrared area. The requirements which must be satisfied by a spectrograph intended for operation with electron-optical amplifiers are discussed. Summary information is also given on the construction of a powerful light diffraction spectrograph with a photocontact electron-optical device, which was used in obtaining the infrared spectra of diffusion fogginess. M.G.J.

N67-17217# Cambridge Systems, Inc., Newton, Mass.

DESIGN, DEVELOPMENT AND TESTING OF AN ACOUSTIC ANEMOMETER Final Report, 1 Jun. 1963–31 May 1966

David J. Beaubien, Arthur Bisberg, and Arthur Pappas Jun. 1966 65 p refs

(Contract AF 19(628)-2988)

(AFCRL-66-650; AD-641574) CFSTI: HC $3.00/MF $0.65

This report covers the development and testing of an acoustic anemometer which provides an instantaneous visual display of wind speed. The anemometer system consists of three units: an acoustic transducer array consisting of three orthogonally mounted transducer-pairs which sense the wind velocity components, a transmit unit which analyzes the information provided by the array, and a display unit offering a visual presentation of the electrical data developed at the transmitter unit. The system is intended to provide a measurement range of 0 to 150 knots, with a resolution of 1 knot. The overall accuracy for the system is plus or minus 3% of the reading, plus or minus one digit. An extensive laboratory and field test program, designed to verify the suitability of the system for use in extreme climates was conducted, and the results of these tests are presented. The system described is intended for operational use at missile sites and ranges. Author (TAB)

N67-17317# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

INSTRUMENTING OF THE QUEEN AIR AIRCRAFT FOR SAMPLING OF A ZINC SULFIDE ATMOSPHERIC TRACER

P. W. Nichols *In its* Phys. Sci., Vol. I May 1966 p 11–13 refs (See N67-17312 07-13) CFSTI: HC $3.00/MF $0.65

A Beechcraft 80 aircraft was fitted with a zinc sulfide detection system to permit the use of the aircraft in atmospheric diffusion studies involving zinc sulfide tracer. Installation and calibration of the detection equipment are described. Calibration curves are plotted for the concentration measurements of two units. A.G.O.

N67-17361 National Bureau of Standards, Boulder, Colo.
CONFERENCE ON PRECISION ELECTROMAGNETIC MEASUREMENTS
1966 71 p Conf. held Boulder, Colo., 21–24 Jun. 1966
(AD-642776) CFSTI: HC $3.00/MF $0.65

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N67-17363 National Bureau of Standards, Boulder, Colo.
TIME AND FREQUENCY
In its Conf. on Precision Electromagnetic Meas. 1966 p 18–30 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

Abstracted data are given from conference presentations on time and frequency. Reviews of the following reports are included: (1) intercomparison of hydrogen and cesium atomic frequency standards, (2) clock synchronization via Relay II Satellite, (3) meteor burst time synchronization, (4) dual frequency vlf timing, (5) 5 MHz reference oscillator for time and frequency standard applications, (6) FM noise spectra measurement of low-noise vhf crystal controlled oscillators, and (7) mechanical model of random perturbations which generate a noise spectral density law with reference to the flicker noise law. A.G.O.

N67-17364 National Bureau of Standards, Boulder, Colo.
DIRECT CURRENT AND LOW FREQUENCY, I
In its Conf. on Precision Electromagnetic Meas. 1966 p 31–44 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

A synopsis of conference papers from various research projects in the field of direct current and low frequency is presented. The topics summarized are as follows: direct current comparator ratio bridge for four terminal resistance measurements, increased accuracy for resistance measurements, precision measuring equipment for electrical power in the range of audio frequencies, stress sensitivity of Manganin resistor on high current precision coaxial shunt, potentiometer for the range from nanovolt to 10 volts, magnetic potentiometer of high precision, and precise current regulation with a transductor. A.G.O.

N67-17365 National Bureau of Standards, Boulder, Colo.
DIRECT CURRENT AND LOW FREQUENCY, II
In its Conf. on Precision Electromagnetic Meas. 1966 p 45–57 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

Developments in the field of direct current and low frequency are reviewed. Abstracted data are presented from research on topics such as: (1) direct reading comparator bridge for scaling four terminal impedances at audio frequencies, (2) SELF-balancing current comparator, (3) thermal converters as ac–dc transfer standards for measuring alternating voltage, (4) high frequency performance of feedback amplifier-transformer combinations, (5) potentiometric technique for analog to digital conversion, and (6) precision measurements of kilovolt pulses. A.G.O.

N67-17367 National Bureau of Standards, Boulder, Colo.
MICROWAVES, I
In its Conf. on Precision Electromagnetic Meas. 1966 p 72–81 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

Abstracted data are presented from several conference papers on microwave measuring instruments and techniques. Developments are summarized from research on high frequency wattmeters operated by forces arising from a rate of change of electromagnetic momentum, a coaxial radio frequency power standard, a thin film bolometer unit, calibration of coaxial adapter transfer standards, system for transfer of calibration factor for coaxial bolometer mounts with 1% transfer accuracy, and skin effect corrections in immittance and scattering coefficient standards employing precision airdielectric coaxial lines. A.G.O.

N67-17369 National Bureau of Standards, Boulder, Colo.
THE NATIONAL MEASUREMENT SYSTEMS OF VARIOUS COUNTRIES
In its Conf. on Precision Electromagnetic Meas. 1966 p 93–94 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

A list of suggested topics for an informal discussion on the measurement systems of different countries is presented. Consideration was given to subjects of common interest such as: the type of organization in each country for measurements and measurement standards, the specific mission of each national laboratory or equivalent organization, and the research projects being conducted in the various laboratories. A.G.O.

N67-17370 National Bureau of Standards, Boulder, Colo.
MICROWAVES, II
In its Conf. on Precision Electromagnetic Meas. 1966 p 95–108 p 95–108 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

Abstracted data of conference presentations on microwave measurement instruments and techniques are presented. Papers on the following topics are included: (1) the bolometer as a mixer in precision swept frequency homodyne instruments, (2) an absolute electrodynamometer for high frequency currents, (3) evaluation of an absorption stark voltmeter, (4) a 94 GHz confocal frequency reference, (5) non-destructive resistivity and thickness measurement, (6) apparatus for accurate measurements of parameters of ferrites at low temperature and X-band frequencies, and (7) interpretation of ferromagnetic resonance measurements made in a nonresonant microwave system. A.G.O.

N67-17412 European Organization for Nuclear Research, Geneva (Switzerland).
THE APPLICATION OF A BORON COUNTER WITH CH_2 MODERATOR IN NEUTRON DOSIMETRY
L. S. Zolin 1965 15 p refs Transl. into ENGLISH of Joint Inst. for Nucl. Res. Rept. JINR-P-2252
(NP-TR-1394) CFSTI: HC $3.00/MF $0.65

A description of the construction and characteristics of a boron counter with CH_2 moderator for neutron dosimetry are presented. NSA

N67-17425 California Univ., Livermore. Lawrence Radiation Lab.
METHOD FOR DETERMINING THE RESPONSE OF TEMPERATURE SENSORS TO A RAPID TEMPERATURE RISE

Robert Parker 28 Apr. 1966 11 p Presented at the Instr. Soc. of Am. Meeting, New York, Oct. 1966 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-12484, Rev. 2; CONF-661004-1) CFSTI: HC $3.00/MF $0.65

A capacitor discharge technique was used to pulse heat a metal strip very quickly (30 μsec) and the response of a temperature sensor bonded to the strip was measured, to give the temperature response of the sensor. The analytical solution for the response of the sensor was compared with the experimental data, with very good agreement. It was concluded that the glue-line and backing thicknesses govern the response of the sensor. A possible non-destructive method for determining the response of a temperature sensor and a strain gage, to be used in the field on a structure encountering pulse heating, is proposed.
Author (NSA)

N67-17436# Stanford Univ., Calif. Linear Accelerator Center.
REFINEMENTS IN PRECISION KILOVOLT PULSE MEASUREMENTS
W. R. Fowkes and R. M. Rowe Jun. 1966 35 p refs Presented at the Conf. on Precision Electromagnetic Meas., Boulder, Colo., 21–24 Jun. 1966
(Contract AT(04-3)-400)
(SLAC-PUB-199; CONF-660637-1) CFSTI: HC $3.00/MF $0.65

Techniques for reducing errors encountered in measuring the amplitude of 100–300 kV pulses which are a few microseconds in length are described. The accuracy to which such measurements can be made depends, for the most part, on how precisely the behavior of the voltage dividing network is shown. Problems due to stray reactances, temperature, voltage effects, dielectric and dimensional instabilities, losses, improper terminations and external circuitry are dealt with, with particular emphasis on capacitive voltage dividers. Also described briefly are an ultrastable laboratory standard divider, calibration techniques, and measuring instrumentation.
Author (NSA)

N67-17467# Argonne National Lab., Ill.
CHARGE COLLECTION AND CHARGE-COLLECTION TIME IN SEMICONDUCTOR PARTICLE DETECTORS
Niels J. Hansen Jun. 1966 27 p refs
(Contract W-31-109-ENG-38)
(ANL-7226) CFSTI: HC $3.00/MF $0.65

Charge collection in semiconductor junction and lithium-drifted, charged-particle detectors was investigated. Analytical solutions were obtained for the charge collected as a function of time and for the charge-collection times in terms of a parameter $\beta_0 = X_0/D$, the reduced range of the incident ionizing particle. It is assumed that the stopping power, dE/dx, of the detector is constant, that there is no loss of carriers by trapping or recombination, and that the mobilities of the carriers are constant, independent of the field strength. The implications of these simplifying assumptions are discussed. Figures are presented to illustrate the dependence of the pulse shape on the parameter β_0, and optimum operating conditions for the detectors are established. The effect on the collection time of the high fields in the ionization column is estimated.
Author (NSA)

N67-17590# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
MOTION SENSING AND ITS APPLICATION TO PROJECT WISP
C. Hudson, R. Lagerquist, and D. Rutland Feb. 1966 89 p refs
(Contract AT(29-1)-1183)
(EGG-1183-2078; UCRL-13206; S-319-R) CFSTI: HC $3.00/MF $0.65

The field of motion sensing for possible solutions to motion sensing problems associated with Project WISP are examined. Motion sensing principles are outlined, devices and systems are evaluated, and promising avenues for further research are recommended.
Author (NSA)

N67-17591# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A NEW NEUTRON AND HIGH ENERGY PARTICLE DOSIMETER FOR MEDICAL DOSIMETRY APPLICATIONS
W. V. Baumgartner, L. W. Brackenbush, and C. M. Unruh 29 Jul. 1966 15 p refs Presented at Symp. on Solid-State and Chem. Radiation Dosimetry, Vienna
(Contract AT(45-1)-1830)
(BNWL-SA-619; CONF-661005-1) CFSTI: HC $3.00/MF $0.65

Principles, design, and performance of solid state track dosimeters are discussed. For neutron detection, a strip of plastic is used with a fissionable foil attached to it. Neutrons induce fission in the foil, and the fission tracks in the plastic can be detected by using etchants which preferentially attack the damaged areas. For proton detection, proton-fissionable foils can be used. Alpha particles and higher nuclei leave their own tracks directly in appropriate plastic detectors. However, large fluxes and doses of particles on photons, which do not provide a minimum critical rate of energy loss in traversing a material, do not leave tracks. Cobalt-60 gamma radiation doses to 10^8R have not produced observable damage. Flat, cylindrical, and spherical detector designs are described. Methods of determining dose from exposed devices are given.
NSA

N67-17593# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
INTERFEROMETER FOR THREE WAVELENGTHS: 2.5 mm, 4 mm, AND 8 mm [INTERFEREOMETER FUER DREI WELLENLAENGEN: 2.5 mm, 4 mm UND 8 mm]
M. Michaelis Jun. 1966 56 p refs In GERMAN; ENGLISH summary
(IPP-2/49)

The interferometer was designed to measure simultaneously the phase shifts of three superimposed microwave beams transmitted across a common plasma path. An "optical" transmission with teflon lenses, oversize waveguide, parallel plate filters, and wire grid was developed for the 2.5-mm wavelength and for the three wavelengths in the measurement channel. Conventional waveguides were used elsewhere. A zebra stripe display was obtained by means of long reference arms and provided direct phase-shift readings for all three wavelengths with a maximum sensitivity of 10°. A graphical method for error evaluation is given. The interferometer permits plasma density measurements between 10^{12} and 10^{14} particles/cc.
Author (NSA)

N67-17595# California Univ., Livermore. Lawrence Radiation Lab.
A STUDY OF FISSION γ RAYS USING A Ge(Li) DETECTOR IN CONJUNCTION WITH A BENT-CRYSTAL SPECTROMETER IN CAUCHOIS GEOMETRY
D. H. White, W. John, B. G. Saunders, and D. J. Groves 20 Jul. 1966 7 p Presented at Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 12–17 Sep. 1966
(Contract W-7405-ENG-48)
(UCRL-70000; CONF-660906-24) CFSTI: HC $3.00/MF $0.65

The high-resolution capability of the bent-quartz-crystal spectrometer in Cauchois geometry was extended above 400 kev by replacing the photographic emulsion with a Ge(Li) detector and using multichannel pulse height analysis. By proper collimation at

the focal circle, extended spectral bands of fission γ rays are recorded which are free of Compton edges and other secondary processes. Author (NSA)

N67-17634*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NEW LOOK AT THE BROWN–TWISS INTERFEROMETER
Frank C. Jones Jan. 1967 28 p refs
(NASA-TM-X-55657; X-641-67-13) CFSTI: HC $3.00/MF $0.65
CSCL 14B

A series of simple steps to the spatial correlation pattern of light from an extended source is shown to follow the simple notion of an interference pattern that jumps randomly. This jumping pattern leaves a footprint in the form of the intensity autocorrelation function, which is measured by the Brown–Twiss stellar interferometer. Spatial dependence of the intensity fluctuation correlation is discussed for sources that radiate a scalar amplitude; and the description given corresponds to a completely polarized source or to measurements made with aligned polarizing filters over the detectors. This model is refined for the case of completely unpolarized sources; and the necessary equations are evolved. The communication between quantum and classical description, and a detailed source model are treated in appendixes. M.W.R.

N67-17651# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE RAPID ACTING MICROWAVE INTERFEROMETER WITH DIRECT PHASE READING
V. G. Grigorenko and L. A. Dushin 7 Dec. 1966 14 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 11, 1964 p 1185–1191
(FTD-HT-66-272; TT-67-60194; AD-643622) CFSTI: HC $3.00/MF $0.65

A wide use of microwave methods has recently been found for plasma diagnostics, whose advantage is that during their application to the plasma, disturbances do not occur because the devices antennas, which send sounding signals, may be situated beyond the vacuum volume occupied by the plasma. The largest suitable device for such measurements are microwave interferometers, which allow the observation of terminal changes in electron concentration in the plasma and partial collision with time when measuring the extinction of signals. In addition, interferometers allow measurements of pulse processes to be carried out, which are characteristic for modern experimental installations for plasma investigation. In this paper a comparison of different interferometer diagrams is given, and an interferometer with an electronic computer is described. Author (TAB)

N67-17662# Army Electronics Labs., Fort Monmouth, N. J.
PHOTOMETRIC CALIBRATION OF AUTOMATIC EXPOSURE CONTROL SYSTEMS
John A. D'Agostino Aug. 1966 19 p
(ECOM-2748; AD-640575) CFSTI: HC $3.00/MF $0.65

Photometric equipment and techniques designed to calibrate photographic automatic exposure control systems are presented. A J.A. Maurer Automatic Exposure Control, Model 1222, designed for aerial use is tested by these means and the calibration test results are presented, discussed, and compared with both the manufacturer's specifications and the standard aerial exposure index. Future refinements of these techniques are outlined. Author (TAB)

N67-17669# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.
PIEZORESISTIVE STRAIN GAGE ACCELEROMETERS
E. J. Evans Dec. 1966 79 p refs
(PA-TR-3374; AD-643751) CFSTI: HC $3.00/MF $0.65

Semiconductor strain gages have been successfully integrated by diffusion into silicon spring members, resulting in microelectronic transducers. This concept of using force as an input parameter to an integrated circuit has been shown to be feasible for many military applications including accelerometers, pressure transducers, and vibration pickups. The principal topics covered in this report are (1) characterization of integrated semiconductor strain gage materials, (2) theory of integrated transducer design for a military environment, (3) integrated circuit force sensor fabrication techniques, and (4) design, fabrication, and evaluation of a typical accelerometer. Author (TAB)

N67-17682# California Univ., Livermore. Lawrence Radiation Lab.
ALICE MACHINE TAPE-RECORDER DATA ACQUISITION SYSTEM
A. F. Waugh and C. J. Maxwell 23 Sep. 1966 16 p Presented at the Symp. on Eng. Probl. of Controlled Thermonucl. Res., Gatlinburg, Tenn., 3–6 Oct. 1966 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-70018; CONF-661016-15) CFSTI: HC $3.00/MF $0.65

A multichannel, instrumentation-type, tape recorder used together with a multichannel light beam oscillograph has proven very satisfactory as the main data acquisition and reproduction system for the Alice machine experiment. The Alice machine, with its magnet-on time of up to 20 sec and neutral beam injection period of 3 to 10 sec, is neither a d-c machine or a pulsed machine. During the trapping time of several seconds it is impossible to capture all of the available data by oscilloscope camera methods, although this was the method relied on prior to the use of the tape recorder. Now, nearly all the signals of interest are simultaneously and continuously recorded and reproduced by the tape machine onto the oscillograph during the entire injection interval and decay time which follows. This initial analog, hard-copy printout is immediately available after each shot for comparison of relative amplitudes and envelope shapes. Any part of this record can then be subsequently reproduced at different tape and chart speeds to obtain the time resolution desired. The 14-channel tape recorder with its direct mode frequency response to 250 Hz to 300 kHz and fm mode frequency response of 0–40 kHz can operate at any of the standard eight speeds from 15/16 ips to 120 ips. The maximum chart speed of the oscillograph instrument is 100 ips. With the maximum frequency reduction capability of 128/1, 40-kHz signal can be reproduced as a 312-Hz signal and printed at a very readable 3.12 cycles per inch. At present the tape recorder is mounted on a portable base, together with a full rack of auxiliary equipment including the following, in addition to the oscillograph: Multiple-gain-step signal-conditioning voltage amplifiers, galvanometer amplifiers, a calibration signal source, and timing sequence controls and input patch panels for all of the above, making it a complete versatile, self-contained data acquisition and reproduction system. Author (NSA)

N67-17688# Commissariat a l'Energie Atomique, Saclay (France). Section d'Applications des Radioéléments.
CONSTRUCTION OF A β-X FLUORESCENCE GAUGE FOR CHEMICAL ANALYSIS [REALISATION D'UNE JAUGE A FLUORESCENCE β-X POUR L'ANALYSE CHIMIQUE]
Ioannis Leontiadis (Ph.D. Thesis—Paris Univ.) Jun. 1966 60 p refs In FRENCH
(CEA-R-2970)

A theoretical and experimental study of phenomena occurring when beta radiation from a radioactive source causes X fluorescence in the atoms of a sample is discussed. A semi-empirical equation

is put forward for calculating the intensity of the photoelectric peaks caused by the elements which are being determined. The set-up proposed has a much better performance than that of previous β-X equipment. It is now possible to apply this new method both to chemical determinations and to layer-thickness measurements. The process has proved to be slightly more satisfactory than that using tritium-on-zirconium sources for producing X excitation. An extension of this work is proposed for the case where the matrix effects are taken into account for determining the contents. Author (NSA)

N67-17702# General Dynamics/Fort Worth, Tex.
DEVELOPMENT OF A HIGH-INTENSITY SOLID-STATE GAMMA-RAY DOSIMETER SYSTEM
C. L. Fletcher 18 Jul. 1966 63 p refs
(Contract N228(62479)67947)
(FZK-287; USNRDL-TRC-53; AD-641654) CFSTI: HC $3.00/MF $0.65

Design, construction, and testing of an integrating gamma-ray dosimeter for high dose rates are discussed. The sensor is a silicon surface-barrier detector operating as a current device. The detector output current is integrated on a capacitor. When the voltage on the capacitor rises to a predetermined level corresponding to 10 rad-equivalent-air of gamma-ray dose, the capacitor is discharged and the instrument produces an output pulse to signal the event. The number of output pulses indicates integrated dose, and the pulse repetition rate indicates dose rate. The detector proper is cooled with a thermoelectric cooler to minimize and stabilize leakage current. The instrument is designed for operation in the dose-rate range of 10 to 100,000 rad-equivalent-air per second. The detector is constructed to make it function as a Bragg-Gray device over the gamma-ray energy range of 80 kev to 12 Mev. The detector is reasonably isotropic; cumulative errors due to all causes are less than plus or minus 30%. The electronics are insensitive to gamma-radiation transients for dose rates as high as 1,000,000 rad per second. Results of tests with radioactive sources, a fast-burst reactor, and bremsstrahlung pulses are given. Author (TAB)

N67-17705# Solid State Radiations, Inc., Los Angeles, Calif.
FLUOR-PHOTODIODE GAMMA RAY DOSIMETER Final Report
M. R. Zatzick, H. S. Katzenstein, J. Friedericha, R. Higa, J. Underwood et al 21 Sep. 1965 113 p refs
(Contract N228(62497)68124)
(SSR-1F2704-65; AD-641913) CFSTI: HC $3.00/MF $0.65

A fluor-photodiode gamma ray dosimeter, nicknamed Fluorad, was designed, fabricated, and extensively tested and calibrated. The instrument (sensor head plus recycling circuit) provides output pulses suitable for low sensitivity scaler inputs. The total count (x 10) corresponds to the integrated absorbed dose of a given gamma ray exposure in incremental steps of 10 rads (air) per count. The dosimeter is capable of monitoring both steady state or pulsed radiation fields over an intermediate dose rate range of 10 - 100,000 rads/sec. Energy calibration, using side-by-side dosimetry techniques, was carried out over the range 50 keV to 11 MeV. Various types of ion chambers and thermoluminescent dosimeters were used as the calibrating standards. The measured energy response relative to Co60 over the photon energy range, 100 keV to 10 MeV, was virtually constant. An average absolute sensitivity of 1.5 x 10 to the -8th power C/rad was observed. The measured neutron response at 14 MeV was equal to 0.5 times the first collision dose in standard tissue. Other characteristics measured included: pulsed reactor fission neutron and gamma ray response, linearity of frequency vs. dose rate (or current), directional response, temperature range, saturation and recovery time, spurious pulse rate, and radiation effects. The variations in reproducibility for fixed conditions was less than plus or minus 1%. Author (TAB)

N67-17707# Brown Univ., Providence, R. I. Metals Research Lab.
IMPROVEMENT IN ULTRASONIC VELOCITY MEASUREMENT TECHNIQUES Final Technical Report
Bruce B. Chick, George P. Anderson, and Rohn Truell Oct. 1966 18 p refs
(Contract NOw-66-0105-d)
(AD-643081) CFSTI: HC $3.00/MF $0.65

A brute force time interval measurement system capable of resolving changes in time interval of <10 picoseconds (<10 to the minus 11th power sec) has been developed to the point where preliminary measurements are possible with the uncalibrated breadboard system. Good triggering stability and resolution have been obtained but some drift is evident in early performance of the system which does not as yet have temperature control of known temperature sensitive elements. As a preliminary test, the system has been used to measure the small changes in velocity produced by the application of a magnetic field to an aluminum single crystal at room temperatures. Author (TAB)

N67-17720# CTS Corp., Elkhart, Ind. Research and Development Div.
PRODUCTION ENGINEERING MEASURE FOR SUBMINIATURE, TRANSISTOR TYPE POTENTIOMETERS Final Engineering Report, 1 Jul. 1961–30 Sep. 1966
Daniel C. Kinsey and Robert J. Masten 30 Sep. 1966 170 p
(Contract DA-36-039-SC-85978)
(AD-643778) CFSTI: HC $3.00/MF $0.65

This contract established producibility of a 3/8 in. diameter miniature, TO-5 transistor size, general purpose variable resistor. This size control was designed, utilizing principles already proven in on the 1/2 in. diameter, cermet element, variable resistor which was being produced (series 600) at the time the contract was let. The miniature nature of the product led to some difficulties in meeting all the original specification requirements. The problems were solved by corrections of faulty test procedures, by closer control of production processes and some modifications to the original requirements, to make them realistic in terms of a general purpose type variable resistor. Preproduction samples met the final qualification requirements, the pilot run was completed and shipped and the general report for Step II was accepted by the government. Author (TAB)

N67-17745# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPIN OSCILLATOR
R. M. Umerkhodzhayev 16 Sep. 1966 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), v. 19, no. 5, 1964 p 88–89
(FTD-TT-65-1899; TT-67-60257; AD-643720) CFSTI: HC $3.00/MF $0.65

Consideration is given to the necessary parameters of a highly stable retunable spin oscillator. The device described generates a voltage with a frequency equal to the lamor precession frequency, operates without a compensation circuit, and has an instability value of less than 0.0000001. TAB

N67-17781*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
AEROSPACE MEASUREMENT TECHNIQUES
Gene G. Mannella, ed. Washington, NASA, 1967 280 p refs Symp. held at MIT, Cambridge, Mass., 7–8 Jul. 1966
(NASA-SP-132) GPO: HC $1.00; CFSTI: MF $0.65 CSCL 14B

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N67-17782*# National Aeronautics and Space Administration, Washington, D. C.

KEYNOTE ADDRESS

Gene A. Vacca *In* NASA Electron Res. Center Aerospace Meas. Tech. 1967 p IX–XII (See N67-17781 07-14) GPO: HC $1.00; CFSTI: MF $0.65

Future trends and needs of the aerospace program are discussed in the context of measurement technology. Three basic trends are identified as (1) the requirement to integrate a multiplicity of human monitoring and life support instruments for missions involving larger space crews; (2) the demands imposed by longer operational periods; and (3) the need for a larger variety of more complex equipment and more sophisticated experiments due to increases in payload size and mission duration. These, in turn, point out the necessity for obtaining more information rather than raw data; greater instrument reliability and life; absolute calibration for long-term missions; improved measurements for ground facilities to support future missions; and reentry environment simulation studies. The need for new concepts is emphasized. Also stressed is the use of computers to do much of the measurement choreography, with adaptive, computer controlled, integrated instrumentation systems proposed as a possible solution to the problem. M.G.J.

N67-17784*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

USE OF THE GAMMA-RAY BACKSCATTER TECHNIQUE FOR AIR DENSITY MEASUREMENT

John J. Olivero *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 29–42 (See N67-17781 07-14) GPO: HC $1.00; CFSTI: MF $0.65

Details are given on a gamma ray backscatter technique for dynamic measurements of the free stream density with sensor components mounted inside the vehicle. In discussing the backscatter phenomena, the principal interactions of gamma rays with matter, the Compton scattering event are considered. Measurement constraints are assessed in relation to the choice of source, detector, geometry, and the way counts are accumulated to determine a density point. The source imposes the most significant problems. Highlights of the feasibility study program are summarized. It is reported that flight programs have established the feasibility of the technique for ballistic flight in the earth's atmosphere; further studies indicate a natural extension of its use on planetary probes. M.G.J.

N67-17785*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

AEROSPACE MASS SPECTROMETRY

Alfred E. Barrington *In its* Aerospace Meas. Tech. 1967 p 43–72 refs (See N67-17781 07-14) GPO: HC $1.00; CFSTI: MF $0.65

Current and future aerospace applications of mass spectrometry are reviewed, and the principal features of the instrument are schematically represented. As understanding of basic differences in performance requires a knowledge of the process of ion production in the ion source, mass separation in the mass analyzer, and ion detection by the ion detector, each process is described. Performance characteristics, including mass range, resolution, sensitivity, spectrum complexity, and response speed, are discussed in detail. It is pointed out that all mass spectrometers have some fundamental performance characteristics, the optimization of any of which is mutually incompatible with the optimization of at least one of the others. The criteria of minimum weight, size, and power consumption, and the necessity for simplicity, ruggedness, and reliability, are considered. Also discussed are the mass spectrometers designed for rocket and satellite experiments. These include a multiple-collector magnetic instrument equipped with a breakaway vacuum seal, a flight quadrupole gas analyzer, a javeline tandem mass spectrometer design, and a tandem helium mass spectrometer. M.G.J.

N67-17789*# National Aeronautics and Space Administration. Washington, D. C.

REDUCTION OF PICTORIAL DATA BY MICRODENSITOMETRY

Irving L. Kofsky *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 133–154 refs (See N67-17781 07-14) GPO: HC $1.00; CFSTI: MF $0.65

Among the problems examined are those that arise in scanning, computing, and displaying the pictorial information in the two-dimensional matrix of densities that constitutes a recorded image. The important conjugate concepts of spread function and contrast transfer function are introduced to describe the convolution with the scanning instrument in the spatial domain and the filtering in the frequency domain, respectively. A photograph is considered in terms of its line frequency spectra, since this distribution determines the interval at which the density must be sampled; the dimensions of the aperture; and the corrective computer operations that may need to be performed on the output convolution. The differences between the densitometric images produced by two types of optical systems are assessed. These imply that the

microdensitometer should be used for accurate photometric measurements, while the scanner is better adapted for rapid photogrammetric measurement of position on the sample. For displaying photometric data taken from negatives by a microdensitometer, two-dimensional isophot plots have been found extremely useful. M.G.J.

N67-17790*# General Electric Co., New York.
SPATIAL FILTERING: A REPORT ON THE STATE-OF-THE-ART
John M. Holeman *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 155–172 refs (See N67-17781 07-14) GPO: HC$1.00; CFSTI: MF$0.65

The basic principles of enhancement filtering and matched filtering are defined, and the techniques used in both methods are reviewed. In enhancement filtering, the various size details in an image are thought of as different frequencies; with proper spatial filters, any desired band of frequencies can be separated or enhanced. Examples are shown of photographs before and after processing to improve fine detail; to correct for an out-of-focus taking lens, and for motion blurring of the subject; and to remove an overall undesirable pattern. In matched filtering, an attempt is made to match the filter to the diffraction pattern of a particular object. This filter can then be used to extract or recognize this object in a larger mass of information. Consideration is given to the problems encountered in matching the magnification and orientation of the object signal and the signal stored in the filter; in reading information into the system; and in the readout. Examples are included on successful experiments and measured signal-to-noise ratios. M.G.J.

N67-17791*# Michigan Univ., Ann Arbor.
RECENT ADVANCES IN HOLOGRAPHY
E. N. Leith *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 173–189 refs (See N67-17781 07-14) GPO: HC$1.00; CFSTI: MF$0.65

The basic method for making a hologram is described, and based on lasers as the coherent light source are discussed. Details are given on techniques for holographic imagery through diffusing media; holographic recording in three-dimensional media; bias level reduction of incoherent holograms; contour generation; and color holograms. Figures are included to amplify the text. M.G.J.

N67-17792*# Massachusetts Inst. of Tech., Cambridge.
SPECTROSCOPY AT MICROWAVE FREQUENCIES
Malcom W. P. Strandberg *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 191–201 (See N67-17781 07-14) GPO: HC$1.00; CFSTI: MF$0.65

The parameters significant to microwave instrumentation for the measurement of microwave spectra are considered. Parameters are examined mathematically, and several conceptual microwave spectroscope systems are described and shown schematically. It is summarized that a theoretically achievable type of system includes a spectrometer with a klystron, a Stark cell, a crystal detector, a reasonable sort of audioamplifier, a Stark modulator, and an operator with an unbounded capacity to pay attention to details. A.G.O.

N67-17794*# Air Force Cambridge Research Labs., Bedford, Mass.
INFRARED FOURIER TECHNIQUES
A. T. Stair, Jr. *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 217–227 refs (See N67-17781 07-14) GPO: HC$1.00; CFSTI: MF$0.65

Important developments in the field of Fourier spectroscopy are discussed, and some successful results obtained by using interferometric spectroscopy are described. Emphasis is placed on the near-infrared region of the spectrum. Significant advantages of throughput and multiplexing are pointed out, and the rediscovery of a mathematical algorithm which can be used to reduce the digital computation time by two orders of magnitude is mentioned. The use of Fourier spectroscopy to obtain the first infrared spectra of high altitude nuclear detonations is also noted. It is concluded that the fundamental problems of Fourier spectroscopy have been solved, and the very significant advantages over monochromators in the infrared region have been experimentally verified. A.G.O.

N67-17795*# University of Southern Calif., Los Angeles, Calif.
LIGHT SOURCES AND DETECTORS FOR VACUUM ULTRAVIOLET RADIATION BETWEEN 1000 Å AND 100 Å
G. T. Weissler *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 229–261 refs (See N67-17781 06-14) GPO: HC$1.00; CFSTI: MF$0.65

Technological developments are summarized for sources and detectors in the area of photon-matter impact research, including the study of photon interaction with atomic or molecular gases, with gaseous hot plasmas, or with solid surfaces. Light sources which operate on the principle of pulsed condenser charges such as: the rare gas continuum source, sliding spark source, thermonuclear devices, water-cooled cascade arc, and dense metal plasmas produced by the focusing of a Q-switched high power laser on a metal are described. Detectors useful for the wavelength region below 1000 Å such as: Samson's ionization chamber, the continuous-strip photomultiplier, the photoemission scintillation device, a side-window Geiger counter, and silicon p–n junction photodiodes are also discussed. A.G.O.

N67-17802# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
DETERMINATION OF THE PROPERTIES OF A SENSOR FOR ANGLES OF INCIDENCE AND SIDEWASH FOR ELDO-A FIRINGS
J. H. A. Te Boekhorst, S. O. T. H. Han and M. M. P. Van Boxtel May 1966 70 p refs
(G-43) CFSTI: HC$3.00/MF$0.65

During firings of the ELDO-A vehicle, aerodynamic angles of incidence and sidewash will be measured by means of a sensor on the spherical part of the nose cone, consisting of 5 pressure orifices. One of the orifices is situated on the vehicle centerline, the others are placed 90 degrees apart at symmetric positions on the sphere where the normal to the sphere makes an angle of 45 degrees with the vehicle centerline. Wind tunnel tests were performed in the Mach number range from M = 0.35 to M = 3.0, to determine the properties of such a sensor. A pressure difference ratio was found which is, up to M = 1.4, a function of angle of incidence (or sidewash) and Mach number. Above M = 1.4 this pressure difference ratio appeared to be independent of Mach number, as predicted by theory. Author (ESRO)

N67-17814# Royal Aircraft Establishment, Farnborough (England).
AN INVESTIGATION INTO THE USE OF EPOXY CASTING SYSTEMS IN THE MANUFACTURE OF TRANSDUCERS
E. F. Price and Margaret Chapman Mar. 1966 129 p refs
(RAE-TR-66094; AD-642979) CFSTI: HC$3.00/MF$0.65

The report gives information on experiments carried out to investigate the use of a simple epoxy gravity moulding system for making transducer components (excluding pressure sensitive elements) in small numbers, where the purchase of complex or

expensive moulding apparatus would not be justified. The test results obtained from transducers using cast epoxy bodies are shown, together with an analysis of their performance under different environmental conditions. The possible saving in material cost and the reduction in weight which can be realized by employing this system is shown, and a comparison made between the time required to produce an epoxy casting and the time necessary to make the same body by normal machining methods. Author (TAB)

N67-17833*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AN APPLICATION OF THE ELECTROMAGNETIC FLOWMETER FOR ANALYZING DYNAMIC FLOW OSCILLATIONS

Houston M. Hummac 23 Jan. 1967 42 p refs

(NASA-TM-X-53570) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Development of an electromagnetic flowmeter (EMFM) of simple construction to study flow oscillations in turbopump systems is reported. The EMFM described was devised for measuring fluid flow fluctuations from an invariant state to 500 hertz without introducing any obstruction or disturbance to the dynamic transfer characteristics of the turbopump. The potential difference developed across the flowmeter electrodes was measured for fluid velocities ranging from approxmiately 20 cm/sec. to 1500 cm/sec. The EMFM and associated electronic circuitry for detecting the flow signal resulted in a system capable of measuring fluid flow fluctuations over the entire design range for a period of three minutes with an accuracy of ±2%. Author

N67-17842# European Space Research Organization, Paris (France).

ATTITUDE CONTROL: ATTITUDE SENSORS

M. B. Barnes and G. W. Brown (RAE, Farnborough, Engl.) Apr. 1966 38 p refs Presented at the ESRO Summer School, Oxford, 21 Aug. 1964

(ESRO-TM-33) CFSTI: HC $3.00/MF $0.65

Discussed are the basic principles governing the design of sun, earth, and star sensors which may be used in a closed-loop feedback system to stabilize the attitude of a satellite or rocket. Radio and gravity sensors are not included as these are discussed elsewhere. Lack of time prevents the detailed description and comparison of all the many devices which are, or soon will be, available and only a brief outline of these is given here. Author (ESRO)

N67-17882# California Univ., Livermore. Lawrence Radiation Lab.

EFFECT OF PRESSURE ON THE TEMPERATURE CALIBRATION OF Mo/Mo-50 Re THERMOCOUPLES TO 1000°C AND 60 KILOBARS

H. D. Stromberg and D. R. Stephens 15 Jul. 1966 14 p refs Presented at the Am. Soc. of Mech. Engr. Ann. Winter Meeting, New York, 27 Nov.–2 Dec. 1966

(Contract W-7405-ENG-26)

(UCRL-14993; CONF-661102-3) CFSTI: HC $3.00/MF $0.65

The effect of pressure on the emf of Mo/Mo–50% Re thermocouples was compared to that of Cr/Al. The pressure effect compared to Cr/Al was small, about 7°C at 40 kbar and 1000°C. It is believed that strain on thermocouple wires caused by deformation in high-pressure systems has a significant effect on the measured temperatures. For example, it has been reported that Cr/Al thermocouples will read as much as 8°C low at 700°C after cold work. This effect may explain differences in the reported pressure dependence of emf for Cr/Al thermocouples. One-atmosphere emf temperature calibrations also are given for Mo/Mo–50% Re and for Re/Mo–30% Re thermocouples. Author (NSA)

N67-17927 Royal Aircraft Establishment, Farnborough (England).

EXPERIENCE WITH THE PRODUCTION TESTING OF THE LATENSIFICATION OF DS-5 FILM [OPYT PROIZVODSTVENNOGO OPROBOVANIYA LATENSIFIKATSII PLENKI DS-5]

Ts. S. Arnold, L. P. Krylov, and G. G. Shavyakov Oct. 1966 7 p refs Transl. into ENGLISH from Tekhn. Kina i Televideniya (Moscow), no. 3, Mar. 1965 p 50

(RAE-LIB-TRANS-1179) CFSTI: $3.00

Latensification of the Soviet DS-5 color-negative film by means of 10 min exposures to independent sources of red, green and blue light, corresponding to the sensitivity bands of the three emulsion layers, increases the speed of the film by a factor of approximately 3. This is confirmed by results obtained in the practical use of the film. Author

N67-17937 Central Lab. for Radiological Protection, Warsaw (Poland).

COSMIC RAY BACKGROUND IN SILICON SPECTROMETER

M. Jagusztyn, W. Przyborski, J. Roman, and M. Slapa 1966 23 p refs Submitted for Publication

(CLOR/IBJ-54/D) CFSTI: $3.00

Measurements of the pulse-height distribution and intensity of cosmic ray background in silicon spectrometers are presented for various detector thicknesses. An average count due to cosmic rays was found to be 1.43 ± 0.11 cpm per sq. cm of detector sensitive area. A low-background beta-ray spectrometer has been constructed with two silicon detectors operated in anticoincidence. The background count measured in the energy region above 15 keV was less than 0.3 cpm per sq. cm. Author

N67-17948*# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Group.

GIANT APERTURE TELESCOPE STUDY

J. Buckley 14 Dec. 1966 264 p refs

(Contract NAS7-100; JPL-951288)

(NASA-CR-81677; ER-8558) CFSTI: HC $3.00/MF $0.65 CSCL 17H

Phase II results are presented of a design study to determine the optimum configuration and engineering guidelines for the ground receiver of a deep space optical communications system. A 120-in fully steerable telescope for coherent detection at a wavelength near 10 microns was studied. The telescope's astronomical ability was examined and found to be well suited for its primary role as a coherent optical deep space communications receiver as well as a general purpose astronomical telescope. The discussion provides details on selecting a mount configuration, acquisition and tracking, the mechanical design of the telescope and mount, the optical system, the communications system tracking servo, system performance analyses, an error analysis, site location considerations, building and dome considerations, the telescope's astronomical utility, and an evaluation of a multiple aperture receiver. R.N.A.

N67-17964# International Training Centre for Aerial Survey, Delft (Netherlands).

AN EXPERIMENT FOR A PHOTOMAP OF SAUDI ARABIA

C. Koeman 1966 23 p refs *Its* Ser. A, no. 38; *Its* Ser. B, no. 39

CFSTI: HC $3.00/MF $0.65

A procedure for the production of a photomap in four colors is described. Emphasized is the need for the adoption of the offset-printed photomosaic as the provisional topographic map for those countries where topographic maps are lacking, as well as

for those countries where a complete coverage of vertical aerial photographs is available. Included is a photomap of Saudi Arabia which illustrates the validity of the technique. A recommended method for the production of a four-color photomap and an alternative method are discussed. Also included are data on photo-lithographic techniques and guidelines for paper selection.
S.C.W.

N67-17955*# American Science and Engineering, Inc., Cambridge, Mass.
A LABORATORY PROGRAM TO DEVELOP IMPROVED GRAZING INCIDENCE X-RAY OPTICS
T. Zehnpfennig, R. Giacconi, R. Haggerty, W. Reidy, and G. Vaiana Oct. 1966 86 p refs
(Contract NAS5-3992)
(NASA-CR-81670; ASE-1378) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The design and fabrication of grazing incidence double reflection optics is discussed. Tests, equipment, and laboratory techniques useful for the evaluation of these telescopes are described, and the properties of several fabricated telescopes are presented. A resolution of a few arc seconds has been obtained in visible light. X-ray measurements were limited by the available techniques, but the resolution measured at 8A is better than 30 arc seconds. Typical telescope double reflection efficiencies are on the order of 20% at 8A.
Author

N67-17987*# New Mexico State Univ., University Park.
A MODIFIED HYPERSENSITIZATION PROCEDURE FOR EASTMAN KODAK I-Z SPECTROSCOPIC PLATES
Thomas P. Pope and Thomas B. Kirby Dec. 1966 9 p refs
(Grant NsG-142-61)
(NASA-CR-81658; TN-701-67-13) CFSTI: HC $3.00/MF $0.65 CSCL 14E

A hypersensitization procedure for Eastman Kodak I-Z spectroscopic plates is described. The primary objective was to minimize or eliminate nonuniform plate fog. This procedure gave a mean plate fog density and density range of 0.28±0.01. The hypersensitizing agent is, typically, an ammonium hydroxide solution and use is made of an acetic acid mixture as a stop bath. Some effects of bath temperature, ammonium hydroxide concentration, and hypersensitized plate storage are given. An approximate value of 350 to 450 was obtained for the increase in sensitivity of a hypersensitized I-Z over an unhypersensitized I-Z.
Author

N67-17998* Fairchild Camera and Instrument Corp., Syosset, N. Y.
CAMERA AND FILM PROCESSOR
Donald J. Rohrer 1 Nov. 1966 121 p
(Contracts NAS7-100; JPL-950794)
(NASA-CR-81649; SME-AF-22, Suppl. 1) CFSTI: HC $3.00/MF $0.65 CSCL 14E

Experimental tests conducted on the packaging of the saturated PoroMat are summarized. The tests were conducted to determine the relationship of storage time versus usability of PoroMat sealed in a continuous plastic packaged in a controlled environment. The discussion covers the original design analysis of the packaged PoroMat investigation of various packaging materials, description and results of the tests conducted, supplementary tests, and recommendations for further tests. Also included are the specification, design analysis, and operation and maintenance instructions for a camera and film processor for use in a photographic system capable of high resolution reconnaissance of the Martian surface from an orbiting spacecraft.
R.N.A.

N67-18002* Astro-Space Labs., Inc., Huntsville, Ala.
DEVELOPMENT OF A PRESSURE AND FORCE TRANSDUCER CALIBRATION PROCEDURE FOR THE HYPERSONIC SHOCK TUNNEL, VOLUME I Final Report, May 1963–Oct. 1966
Robert F. Pickard and J. R. Loyd 17 Jan. 1967 57 p ref
(Contract NAS8-5350)
(NASA-CR-81713; ER67-2, Vol. I) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An investigation of pressure instrumentation, pressure generation, and aerodynamic damping was conducted for application to a hypersonic shock tunnel. Details are given on the pressure transducer study, sound pressure generation systems, pressure transducer mounting study, and forced oscillation dynamic balance system. Studies were carried out to determine the various applications of pressure transducers in the environment of shock tunnels, including vibration tests to determine the response to linear acceleration and sensitivity to cross-axis acceleration. The design of a low frequency–high sound pressure level system is discussed. A high frequency sine-wave sound generating system was developed to furnish the acoustical environment for calibrating piezoelectric pressure transducers and was placed in a low ambient pressure to check the sound levels that could generate at various frequencies.
L.E.W.

N67-18003* Astro-Space Labs., Inc., Huntsville, Ala.
DEVELOPMENT OF A PRESSURE AND FORCE TRANSDUCER CALIBRATION PROCEDURE FOR THE HYPERSONIC SHOCK TUNNEL, VOLUME II Final Report, May 1963–Oct. 1966
Robert F. Pickard and J. R. Loyd 17 Jan. 1967 158 p
(Contract NAS8-5350)
(NASA-CR-81714; ER67-2, Vol. II) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The development of a hypersonic shock tunnel force balance and its associated equipment and calibration techniques are reported. A study conducted to determine the possibility of using strain gauges in the force balance system is discussed, which indicated that piezoelectric sensors offered definite advantages over semiconductor gauges. Consideration is given to an analysis made to determine the required acceleration compensation considering the effect of the model, balance, and sting vibrations on the output of the force sensors when measuring aerodynamic forces. A calibration study was conducted to determine required information, equipment, and procedure, and a static loading system was then designed, built, and tested. After preliminary balance investigation of bench-model force balances, several prototype balances were designed and built, and details are given on the static and dynamic testing carried out. Consideration is also given to filter design, a compensation analog computer, and response tests.
L.E.W.

N67-18004*# Astro-Space Labs., Inc., Huntsville, Ala.
DEVELOPMENT OF A PRESSURE AND FORCE TRANSDUCER CALIBRATION PROCEDURE FOR THE HYPERSONIC SHOCK TUNNEL, VOLUME III Final Report, May 1963–Oct. 1966
Robert F. Pickard and J. R. Loyd 17 Jan. 1967 169 p refs
(Contract NAS8-5350)
(NASA-CR-81716; ER67-2, Vol. III) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Details are given on four areas of development associated with thin film heat transfer gauges: (1) development of a base and thin film gauges that can be heated up to 1000°F, (2) development of the capability to produce thin film gauges contoured to aerodynamic configuration, (3) development of a prototype calibration apparatus that would give improved verification of the

measuring capability of the thin film gauge, and (4) demonstration of procedures and equipment for implementing cost reduction of standard models. Various methods to solve the problem of transferring sufficient heat to the gauges to prevent a temperature lag at the higher base temperatures are discussed. The approach that proved successful was to eliminate the fusion technique and reduce the radiation surface area of the gauge. Molding and grinding were both investigated as techniques for forming contoured substrates, but molding was found to have economic disadvantages. Details are also given on heater control equipment requirements and installation. L.E.W.

N67-18037*# United Control Corp., Redmond, Wash.
INSTRUMENT UNIT TEMPERATURE CONTROL SYSTEM FOR SATURN 1B–SATURN V Technical Progress Report, Jul. 1964–Nov. 1966
Fred Schroeder 27 May 1966 18 p
(Contract NAS8-11759)
(NASA-CR-81679; Rept.-060-0037-001) CFSTI: HC $3.00 CSCL 22D

Production highlights are briefly reviewed, with summary information given on the development of eight production temperature sensor units, eight production controllers; eight production valves, and four production testers. The quality assurance program, including reliability and preflight testing, is outlined. It is reported that the instrument unit control system performed well, and that the design meets the specified requirements. M.G.J.

N67-18114# Joint Publications Research Service, Washington, D. C.
METHODS OF HIGH-SPEED MEASUREMENT IN GAS DYNAMICS AND PLASMA PHYSICS
Yu. Ye. Nesterikhin and R. I. Soloukhin 25 Jan. 1967 98 p refs Transl. into ENGLISH from the Book "Metody Skorostnykh Izmereniy v Gazodinamike i Fizike Plasmy" Novosibirsk, State Univ., 1965 p 1–127
(JPRS-39657; TT-67-30306)

A series of lectures deals with methods of high speed recording of quickly transpiring processes in nonstationary gas dynamics and in plasma physics studies. While different temporal scales are used in gas dynamics and plasma physics investigations, methods of calibration and recording experimental data are essentially the same. Discussions are included of pulse gas dynamics installations, electrodynamic means of obtaining high speed plasma flows, high speed oscillography, mechanical scanning and frame mapping, and electronic-optical systems for recording ultrafast processes. Methods to visualize and measure densities are discussed, as are methods of (1) temperature measurement, (2) ultrahigh frequencies and optical interferometry of plasmas, and (3) rapidly varying pressures in a continuous medium. Mass spectroscopy and power analysis are considered for plasmas. M.W.R.

N67-18122* Arizona Univ., Tucson. Dept. of Physics.
A SIMPLE LIGHT ELEMENT X-RAY SPECTROMETER
Franklin D. Davidson and Ralph W. G. Wyckoff [1966] 24 p refs Submitted for Publication
(Grant NsG-120)
(NASA-CR-81778) CFSTI: $3.00 CSCL 20F

The relatively simple spectrometric apparatus developed for routine work to quantitatively record the K spectra of light elements is reviewed. The problem of a suitable X-ray source was eliminated by producing a windowless tube operating with a cold cathode. Technical details are also given on constant X-ray output, efficiency of X-ray excitation, spectral data, sensitivity, and performance characteristics. The greater sensitivity attained by employing this spectrometer to analyze lighter elements is considered to have been satisfactorily demonstrated. R.L.I.

N67-18124* Rochester Univ., N. Y. Dept. of Physics and Astronomy.
[HIGH RESOLUTION COSMIC RAY CHARGED PARTICLE TELESCOPE] Status Report, Oct. 16, 1966–Jan. 20, 1967
M. F. Kaplon 24 Jan. 1967 24 p
(Grant NGR-33-019-042)
(NASA-CR-81781) CFSTI: $3.00 CSCL 03A

Detector and associated electronics are described for a high resolution cosmic ray charged particle telescope; and detector results are presented for three flights during the summer of 1966. Because of a poor time-altitude flight curve and equipment malfunction, the first flight yielded no useful information; the other two flights in which the detector floated at 2.7 gm/cm^2 produced identical results. Typical responses are shown for the detectors to sea level μ-mesons under various conditions. Clear separation of protons and deuterons is seen in plots for the region of pulse heights containing mainly Z = 1 particles; and another scale emphasizes the Z = 2 particles. The deuteron differential energy spectrum required a large correction for deuterons produced in the residual atmosphere, but contained a finite flux of primary deuterium that indicates an interstellar path length consistent with that applied to the He^3–H^4 data. Deuteron resolution for the 100 to 125 MeV interval is tabulated. M.W.R.

N67-18134*# Dickinson (W. W.) Corp., San Francisco, Calif.
[DEMONSTRATION OF ACOUSTIC SPECTROMETER FOR MEASURING STRESS AND LOCATING FLAWS IN MATERIALS] Final Formal Progress Report
Wade Dickinson 20 Oct. 1966 8 p
(Contract NAS8-20613)
(NASA-CR-81791) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Details are given on the testing and evaluation of an acoustic spectrometer for the nondestructive measurement of stress and location of flaws in materials. Cracks and porosity were detected and located in typical aluminum and titanium welded test objects of 1-in. and .065-in. thicknesses, and quantitative numerical readout of stress was obtained in SI–C LOX tunnel sections. The test setup is described and schematically illustrated. With the wave directors at one fixed position in the setup, as the force was increased it was possible to inspect and cover a large zone of the cylinder and determine quantitatively on which of the time separated, multiple reflection paths the stress was varying. By changing the support method for the tunnel section, combined with the localized radial stress imposition, it was possible to create stress reversal at some points concurrent with monotonic stress increase at others. L.E.W.

N67-18144*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
VARIATIONS IN GAGE CONSTANT AS A FUNCTION OF EMISSION CURRENT IN AN UNSHIELDED OPEN-END GRID BAYARD ALPERT IONIZATION GAGE
Leonard T. Melfi, Jr. and Frederick A. Kern Washington, NASA, Feb. 1967 22 p refs
(NASA-TN-D-3811) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A detailed laboratory study has revealed a gage constant–emission current anomaly in the 1- to 10-millimpere emission current range in an open end grid Bayard–Alpert ionization gauge. This study was performed for the pressure range from 6 x 10^{-2} to 1 x 10^{-6} N/m^2 on an orifice-conductance calibration

system with a computed pressure measurement uncertainty of ±5.5%. Experimental data are presented which show variations in gauge constant as high as 18% for low pressures (pressures less than 10^{-2} N/m^2) and for high emission currents generally used by most investigators. In addition, this anomaly was found to be independent of pressure and, therefore, does not affect the gauge output linearity. However, a knowledge of this behavior is important when calibration procedures with the McLeod gauge are considered, because these procedures require changing the gauge tube emission current. Author

N67-18160*# American Science and Engineering, Inc., Cambridge, Mass.
A LABORATORY PROGRAM TO DEVELOP IMPROVED GRAZING INCIDENCE X-RAY OPTICS
T. Zehnpfennig, R. Giacconi, R. Haggerty, W. Reidy, and G. Vaiana
Washington, NASA, Feb. 1967 87 p refs
(Contract NAS5-3992)
(NASA-CR-717) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The design and fabrication of grazing incidence double reflection optics is discussed. Tests, equipment, and laboratory techniques useful for the evaluation of these telescopes are described, and the properties of several fabricated telescopes are presented. A resolution of a few arc seconds has been obtained in visible light. X-ray measurements were limited by the available techniques, but the resolution measured at 8A is better than 30 arc seconds. Typical telescope double reflection efficiencies are on the order of 20% at 8A. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-16886# Mechanical Technology, Inc., Latham, N. Y.
PROCESS FLUID LUBRICATION Final Technical Report
D. E. Dougherty and C. H. T. Pan Sep. 1966 15 p refs
(Contract Nonr-3731(00) (FBM))
(MTI-66TR50; AD-641369) CFSTI: HC $3.00/MF $0.65

The research program in process fluid lubrication is divided into four functional study tasks: (A) Steam lubrication, (B) Low kinematic viscosity fluids, (C) Materials evaluation for water and steam bearings, and (D) Related analytical studies. TAB

N67-16919*# Santa Clara Univ., Calif.
CONICAL PIVOT BEARINGS FOR SPACE APPLICATIONS
George G. Herzl *In its* Aerospace Mech. 20 May 1966 p 203-222 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

Conical pivot bearing characteristics and performance are analyzed, and criteria for minimal torque design are presented. In the analysis, the fundamental considerations for determining contact pressure between pivot and bearing are identified as the position of the pivot (i.e., horizontal or vertical in analogy to terrestrial applications), and the location of the contact between pivot and bearing (i.e., in the spherical bearing region or on the sloping sides). The crucial part of the design analysis, with respect to minimal friction characteristics, is considered to be the determination of the smallest possible pivot tip radius consistent with the requirement that under all possible operating conditions the tip material will undergo only elastic, and not permanent, deformation. Formulas for calculating optimum bearing dimensions are also derived. It is concluded that conical pivot bearings offer a simple technique for achieving a predictable alignment within a small space and for providing extremely low friction. M.G.J.

N67-17138* North American Aviation, Inc., Los Angeles, Calif.
DEVELOPMENT OF NONDESTRUCTIVE TESTING TECHNIQUES FOR HONEYCOMB HEAT SHIELDS. VOLUME II: LITERATURE, INDUSTRIAL SURVEY, AND BIBLIOGRAPHY
G. Martin, J. F. Moore, and J. W. Rocke 31 Aug. 1966 170 p refs
(Contract NAS8-11733)
(NASA-CR-81525; NA-66-912; Vol. II) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Literature and industrial surveys of pertinent nondestructive testing techniques and equipment were conducted in support of a development program for nondestructive testing of honeycomb heat shields. Literature relating to ultrasonic, radiographic, and other methods of nondestructive testing was collected, reviewed, and indexed. A partially annotated bibliography of pertinent literature was prepared and included with the reported survey results. The literature and industrial surveys, in addition to the contractor's conducted effort, were evaluated and formed the basis for the experimental nondestructive test development program. Author

N67-17157# Naval Ordnance Test Station, China Lake, Calif.
THE APPLICATION OF ULTRASONIC ENERGY TO METAL WIRE DRAWING Annual Progress Report
L. M. Stayton, G. A. Hayes, J. C. Connelly, and A. T. Robinson Oct. 1966 33 p refs
(NOTS-TP-4170; AD-642292) CFSTI: HC $3.00/MF $0.65

A variety of materials and equipment variables were studied during wire drawing under ultrasonic energy radiation. In spite of difficulties concerned with maintaining constant ultrasonic energy environment, reproducible results could be achieved with extreme care. Effects of die temperature, horn diameter, and wire sizes are also reported. Author (TAB)

N67-17158# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
THE OPTIMAL BURN-IN TESTING OF REPAIRABLE EQUIPMENT
John Michael Cozzolino, Jr. Oct. 1966 134 p refs
(Contract Nonr-1841(87))
(TR-23; AD-642105) CFSTI: HC $3.00/MF $0.65

The infant mortality effect observed in the statistical treatment of reliability denotes a decreasing with time of the conditional probability of failure of a device which exhibits it. This widely present effect may be utilized to improve the reliability by means of burn-in testing which seeks to discriminate between high and low quality units by accumulating operating experience upon all units. Burn-in testing is applicable to both unrepairable and repairable devices. The latter case is more difficult since the state of a failed and repaired unit usually depends upon the entire past history of the unit and upon the nature of the repair process. A general burn-in test problem for repairable devices is formulated based upon the explicit modeling of the repair process. The case of unrepairable devices is treated as a special case. Considering a particular conjugate form of the repair rule the burn-in test

optimization is formulated as a sequential decision problem and the solution is discussed in terms of dynamic programming. An adaptive reformulation which allows a parameter of the failure process to be considered unknown is also given. Specific models of decreasing failure rate processes, based upon the population heterogeneity cause of decreasing failure rate, are given. Author (TAB)

N67-17182*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

LOW SOLAR ABSORPTANCE AND EMITTANCE SURFACES UTILIZING VACUUM DEPOSITED TECHNIQUES Final Report, 29 Jun. 1965–28 Sep. 1966

Oct. 1966 82 p refs

(Contract NAS2-3063)

(NASA-CR-73039; Rept.-4-06-66-13) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An investigation was made of the techniques and materials for finishing spacecraft structural surfaces with stable, reproducible, thermal control materials. Coating systems of interest were those with low solar absorptance (α_sO, low infrared emittance (ϵ), and ratios of absorptance to emittance (α_s/ϵ) varying from 2.0 to 0.07. Optical measurements were made of specimens before and after irradiation, with substrates at 294°K and 533°K during irradiation. Results are evaluated in terms of both the morphology of the coating systems and the kinetics due to ultraviolet irradiation and thermal diffusion. Coating systems were selected to satisfy practical engineering requirements. These systems were, (1) quartz substrates with second surface silver for low α_s, (2) polished aluminum alloy substrate with silver overcoated with silica for α_s/ϵ of 1.0 and low α_s, and (3) mill-finish aluminum alloy with silver and alumina overcoat for low ϵ. The systems showed no significant change in absorptance or emittance when subjected to 2000 ESH (equivalent sunhours) at 294°K. Author

N67-17187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PROCEDURES-SPECIFICATIONS-STANDARDS MANUAL

[1966] 423 p

(NASA-TM-X-55624; X-670-64-61) CFSTI: HC $3.00/MF $0.65 CSCL 13H

This document contains procedures, specifications and standards that are presently being used by the Spacecraft Integration and Sounding Rockets Division personnel during the various phases of spacecraft development, mechanical and electrical integration, testing, handling and field operations. Author

N67-17281# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AUTOMATED DRIVES AND THEIR ELEMENTS [AVTOMATIZIROVANNYYE PRIVODY I IKH ELEMENTY]

S. V. Kostina, ed. 22 Apr. 1966 208 p refs Transl. into ENGLISH of Tr. Mosk. Aviats. Tekhnol. Inst. (Moscow), issue 146, 1962 p 1–160

(FTD-MT-64-289; AD-640379) CFSTI: HC $3.00/MF $0.65

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9. EQUATIONS OF THE RELAY TRACK DRIVE L. V. Rabinovich p 174–203 refs (See N67-17291 07-15)

10. THE INFLUENCE PARAMETERS OF THE RELAY TRACK DRIVE ON THE AREA BOUNDARIES OF PHASE SPACE L. V. Rabinovich p 174–203 refs (See N67-17291 07-15)

N67-17282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REPRODUCTION OF SINUSOIDAL OSCILLATIONS BY TRACKING GEAR WHOSE CONTROL ELEMENTS ARE LIMITED IN MOMENT AND SPEED

B. I. Petrov *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 4–36 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

A method of determining the relation of the limiting amplitude of the track shaft oscillations to the frequency is presented, and an analysis is made of the influence of the control element and transmission ratios of the power reducer on the limiting amplitude–frequency relation. The relation of the threshold oscillation amplitude–frequency relations for linear and nonlinear mechanical characteristics, and the acceleration–time constant relation are considered. A method of track drive control element selection intended for sinusoidal oscillation reproduction is outlined, and control element heating problems are mentioned. A method of calculating the friction and moment of resistance in the track shaft is given. The relation of acceleration, speed and drive time constant to the transmission reducer ratio is also considered. N.E.N.

N67-17283# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PARAMETER DEFINITION OF THE SUBSTITUTION CIRCUIT IN THE HOLLOW ROTOR ASYNCHRONOUS MOTOR

B. I. Petrov *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 37–43 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

An experimental method of determining the parameters of the substitution circuit in the asynchronous two-phase motor, based on the single-phase operating conditions, is presented. The rotor drag and loss in steel are considered negligible. It was determined that it is sufficient to measure only the following magnitudes: (1) the active resistances of stator winding of excitation

and control circuits; (2) the total resistances of the excitation and control windings in the motionless rotor; (3) the phase shifts between the current and voltage corresponding to the excitation winding and control winding in the motionless rotor; and (4) the idling speed in single-phase conditions, for which a stroboscopic method is recommended. N.E.N.

N67-17284# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MECHANICAL CHARACTERISTICS OF THE HYDRODRIVE WITH A THROTTLE SPEED ADJUSTMENT

N. A. Borisova *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 44–51 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

The mechanical and regulating characteristics of the hydrodrive, used in servo systems, are described. Pressure loss and pressure distribution are discussed, and expressions are developed for the flow through the throttle valve and for the valve–hydrocylinder system characteristics. Friction in the main lines, and leakage in the hydrocylinder are considered. N.E.N.

N67-17285# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INFLUENCE OF FRICTION IN THE HYDROCYLINDER, LIQUID COMPRESSION AND LEAKAGE IN THE TRANSITION PROCESS, AND DELAY IN THE VALVE–HYDROCYLINDER SYSTEM

N. A. Borisova *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 52–59 ref (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

The transition process is described by a system of first order differential equations which express the pressure change in the right and left hydrocylinders, the volume change–piston displacement, and the hydrocylinder motion. The pressure drop with respect to time is discussed. An equation is developed for the starting delay time in terms of the friction in the system, and it is shown that the starting lag time increases with increased liquid volume. N.E.N.

N67-17286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE DELAY IN THE HYDRAULIC DRIVE WITH THROTTLE ADJUSTMENT

N. A. Borisova *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 60–71 ref (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

A method of calculating the delay magnitude is described, and equations are given for the flow rate and pressure drop. It is noted that the delay increases in proportion to the work volume of the liquid in the drive, and inversely proportional to the discharge coefficient. The relation of the time delay to the pressures and to piston position is also discussed. N.E.N.

N67-17287# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SELECTION OF THE POWER MOTOR AND THE TRANSMISSION RATIOS OF POWER REDUCER OF THE WATCHING DRIVE

B. I. Petrov *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 72–89 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

The mechanical characteristics of the power motor are described and the relation of the net moment on the motor shaft to the rpm of the shaft is discussed. The methods of selecting and obtaining the motor and power reducer transmission ratios and is outlined. Particular cases in which the process of defining threshold values of reducer transmission ratios are identified, and applications to motor operating conditions are delineated. N.E.N.

N67-17289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TOWARD THE CALCULATION OF DRIVES OF THE COMBINED TRACKING SYSTEM

B. G. Krymov *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 119–135 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

Methods of calculation for the angle–angle and the speed–angle types of united tracking systems are presented. The characteristics of united systems with two motors are outlined, and the united drive with combined control is discussed. Expressions are developed for the characteristics, and the resulting logarithmic characteristics are graphed. N.E.N.

N67-17290# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EQUATIONS OF THE RELAY TRACK DRIVE

L. V. Rabinovich *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 136–173 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

The performance characteristics of the electric motor are discussed, and include the linear mechanical characteristics with constant load moment and with dry friction, and the limited moment characteristics. The pattern method is described for the construction of full phase trajectory, and linear and nonlinear motion equations are presented. N.E.N.

N67-17291# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INFLUENCE PARAMETERS OF THE RELAY TRACK DRIVE ON THE AREA BOUNDARIES OF PHASE SPACE

L. V. Rabinovich *In its* Automated Drives and Their Elem. 22 Apr. 1966 p 174–203 refs (See N67-17281 07-15) CFSTI: HC $3.00/MF $0.65

The states of the power motor with positive, negative, and zero applied voltage are described, and the influence of system parameters on the boundary regions between these states are discussed. Details are presented on the static characteristics and the time delay in switching. Linear and nonlinear mechanical characteristics, and their influence on the switching time are considered. Methods are given for determining the phase trajectories for the various delay times. N.E.N.

N67-17437# Bendix Corp., Kansas City, Mo.

RADIUS GENERATION IN VIBRATORY DEBURRING

G. V. Robbins Sep. 1966 37 p
(Contract AT(29-1)-613)
(BDX-613-85) CFSTI: HC $3.00/MF $0.65

Radius generation in vibratory deburring processes may be determined from a series of graphs representing radius generation versus running time. Graphs were constructed for four representative part base metals and a variety of machine-media combinations, from which maximum allowable running time may be accurately predicted in accordance with radius specifications. By comparison

of metal hardness and resistance to abrasion characteristics, the graphic method may be extended to other part materials. The method, through reduction of trial and inspection, has resulted in significant savings in time and reduction of scrap. Author (NSA)

N67-17453# Oak Ridge National Lab., Tenn.
REMOTELY OPERATED EQUIPMENT FOR FABRICATING HFIR TARGET ELEMENTS
M. K. Preston, J. D. Sease, J. E. Van Cleve, Jr., and A. L. Lotts [1966] 29 p refs Presented at the 14th Conf. on Remote Systems Technol., Pittsburgh
(Contract W-7405-ENG-26)
(ORNL-P-2410; CONF-661001-23) CFSTI: HC $3.00/MF $0.65

The target element, which is composed of 35 actinide oxide–aluminum powder pellets clad with an Al tube contained in a target sheath, is fabricated by techniques that embrace power-metallurgical, welding, metal-forming and inspection procedures. Equipment was developed to carry out all steps in the process in three hot cells in the ORNL Transuranium Processing Facility. All development stages have been successfully completed, and a portion of the equipment has been operated with radioactive material. Author (NSA)

N67-17490# Oak Ridge National Lab., Tenn.
REQUIREMENTS FOR FIRE-RESISTANT HIGH-EFFICIENCY PARTICULATE AIR FILTERS
C. A. Burchsted [1966] 12 p refs Presented at 9th Air Cleaning Conf., Boston
(Contract W-7405-ENG-26)
(ORNL-P-2387; CONF-660904-9) CFSTI: HC $3.00/MF $0.65

The establishment of certain basic specification requirements is essential to the procurement of suitable high-efficiency particulate air filters with a minimum of difficulty and cost. Problems have been experienced in the manufacture and procurement of these filters because of inconsistent, ambiguous, and conflicting specification requirements as well as requirements that are not restrictive enough. Requirements for high-efficiency particulate air filters are presented that are intended to guide the specification writer toward standards that will produce uniformity in construction and testing practices to bring the cost of these units down to reasonable levels without sacrificing the necessary performance. Author (NSA)

N67-17506*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCREW-SEAL PERFORMANCE IN VACUUM ENVIRONMENT
John C. Hudelson and Larry P. Ludwig Washington, NASA, Feb. 1967 16 p refs
(NASA-TN-D-3842) CFSTI: HC $3.00/MF $0.65 CSCL 11A

Noncontact seals are being proposed for use in space power systems. These noncontact seals offer reliable operational lifetimes of over 10,000 hours. The leakage rate of mix-bis(mix-phenoxy-phenyl) ether lubricant through a noncontact slinger pump and screw-seal assembly to a simulated space environment was measured. The experimental times ranged from 12 to 100 hours, and the leakage rate extrapolated to 10,000 hours ranged from 0.73 to 2.6 kilograms. Author

N67-17511*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST OF A CRACKED COMPRESSOR BLADE REPAIRED BY ELECTRON BEAM WELDING
Roy D. Hager Washington, NASA, Feb. 1967 12 p refs
(NASA-TM-X-1341) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Results are given for a fatigue test of a maraging steel blade that was repaired by electron beam welding. The repaired blade was initially cracked by a severe bending vibration while being run in a research compressor. Bending fatigue tests to determine the effectiveness of the repair method were performed to a stress level as high as ±61,000 psi before failure occurred. Since the failure did not occur at the weld, but 1/2 inch closer to the tip, electron beam welding can be considered a satisfactory repair method for this type of blade. Author

N67-17564# Michigan State Univ., East Lansing. Div. of Engineering Research.
GROWTH OF PROPERTIES OF METAL AND COMPOUND SINGLE CRYSTALS Final Report, 1 Jun. 1961–30 Jun. 1966
C. T. Wei 30 Jun. 1966 10 p refs
(Contract AT(11-1)-1042)
(TID-23269) CFSTI: HC $3.00/MF $0.65

Laboratory equipment was fabricated and used in production of Zn single crystals with desired orientations and highly finished surfaces. LiF crystals were also produced. Subboundaries of crystals having disorientations of the order of 30 seconds of arc were detected. Studies were completed on work hardening and deformation structure in LiF single crystals. Bicrystals of Zn were produced for twinning studies. The theory of fracture was investigated by calculating the stress field at a grain boundary for 100 equally spaced slip bands containing 100 dislocations at one sign in each band. NSA

N67-17619*# General Dynamics/Convair, San Diego, Calif.
A SURVEY OF WELDING AND INSPECTION TECHNIQUES FOR 2219-T81 ALUMINUM ALLOY Interim Report
W. E. Witzell, M. S. Hersh, and R. T. Anderson Jan. 1967 60 p refs
(Contract NAS3-7951)
(NASA-CR-72097; GDC-ZZL-66-043) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A literature search and industry survey were conducted to determine the best techniques for the welding and inspection of type 2219-T81 aluminum alloy. While no general consensus was obtained for optimum weld or weld repair techniques, relatively imperfection-free welds were reported from automatic techniques such as gas tungsten arc and gas metal arc. The only consistently noted imperfection was porosity. More difficulties were detected for manual weld repairs, particularly when multiple repairs were made in the same area. While various techniques have utility for specific applications, it is concluded that no single known system can consistently identify and measure flaws or cracks in welded structures with sufficient accuracy to be useful for fracture mechanics analyses. Nondestructive testing is discussed in terms of current research and development, instrumentation, and new technology and test methods. M.W.R.

N67-17624*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLLING-ELEMENT FATIGUE LIFE OF SAE 52100 STEEL HOLLOW BALLS
Herbert W. Scibbe, Richard J. Parker, and Erwin V. Zaretsky Washington, NASA, Feb. 1967 17 p refs
(NASA-TN-D-3832) CFSTI: HC $3.00/MF $0.65 CSCL 13I

The NASA five-ball fatigue tester was used to determine the rolling-element fatigue lives of hollow and solid 1/2-inch-diameter (12.7 mm) balls. The upper test balls fabricated from consumable vacuum melt (CVM) SAE 52100 steel were run against SAE 52100 steel lower support balls. Tests were conducted at a maximum

Hertz stress of 800,000 psi (5.52 × 10^9 N/m^2) with no heat added and with a super-refined naphthenic mineral oil as the lubricant. A 10% fatigue life of 60 million stress cycles was obtained for the group of hollow balls and compared favorably to the 10% life of 93 million stress cycles for the solid balls. A confidence level of 66% indicated that the differences in fatigue life between the two groups of balls may be insignificant. The probability of a fatigue spall occurring in the weld area was calculated as 6.5% for those tests in which the running track crossed the weld. One of the 10 fatigue spalls that occurred on the hollow balls was in the weld. This spall was a classical subsurface type similar in appearance to those occurring in the area outside of the weld and in the conventional solid balls. Author

N67-17638*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF ULTRASONIC WRENCH FOR FLARED TUBING CONNECTIONS, VOLUME 1 Interim Report
Herman T. Blaise and Nicholas Maropis (Technidyne Inc.) 8 Dec. 1966 33 p
(NASA-TM-X-53850) CFSTI: HC$3.00/MF$0.65 CSCL 13I

The effectiveness of various ultrasonic vibratory models, frequencies, power levels, and pulse times was investigated for wrench-tightening 0.00635-meter (0.25-inch) aluminum and 0.0127-meter (0.5-inch) stainless steel flared tubing connections representative of the size range from 0.003175 meter (0.125-inch) to 0.0254 meter (1 inch). An ultrasonic torque wrench for flared tubing connections in this size range was designed, built, evaluated, and delivered. Clear evidence of a significant and useful effect was shown by a higher percentage of leaktight connections and by increased breakaway torque on disassembly. The relative hardness of the flare, union, and sleeve was found critical for leaktightness resulting from the increase in wrench rotation that occurs during ultrasonic activation. Author

N67-17646# Naval Avionics Facility, Indianapolis, Ind.
PRESSED FILM TECHNIQUE AND INFRARED SPECTRA CATALOG FOR IDENTIFICATION OF THERMOPLASTICS
James E. Coakley and Hugh H. Berry 1 Sep. 1966 32 p
(NAFI-TR-911; AD-639683) CFSTI: HC$3.00/MF$0.65

A modified compression molding technique for obtaining film of thermoplastics for infrared examination is described. Small specimens of thermoplastic materials were heated to their softening points and pressed into thin, transparent film from which were obtained infrared spectra. The advantages and limitations of this technique are discussed. A pressed film spectra catalog was compiled to be used as a reference for identifying unknown samples. This catalog includes spectra of most of the commercially important thermoplastics, including the newer ones. Author (TAB)

N67-17728# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ISOSTATICALLY PRESSED MAGNESIA STIRRERS FOR ELECTROREFINING PLUTONIUM METAL
A. R. Tater 13 Oct. 1966 7 p
(Contract AT(29-1)-1106)
(RFP-825) CFSTI: HC$3.00/MF$0.65

Several isostatic pressing mold designs were evaluated for fabricating MgO stirrers. Thin walled neoprene molds produced the most satisfactory one-piece stirrers. The pressed stirrers that were developed have been reused as many as five times in the electrorefining process. MgO stirrers formed by suspension casting could be used for only one electrorefining run. Author (NSA)

N67-17733# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
MACHINABILITY OF SOME INFREQUENTLY USED MATERIALS
J. S. Hurst 21 Sep. 1966 24 p refs
(Contract W-7405-ENG-26)
(Y-1550) CFSTI: HC$3.00/MF$0.65

A compilation of methods which have been used for the successful machining of twenty-four material types which are infrequently encountered on a production basis is presented. Methods reflect the craftsman's empirical determinations rather than an exhaustive study of the subject, since the variability of engineering materials precludes an absolute machining procedure unless large quantities of data over long runs are available. However, the data presented can serve either as enabling information for the one-of-a-kind job, or as the starting point for additional research. Author (NSA)

N67-17734# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
OIL RECLAMATION USING MOLECULAR SIEVES
R. DeMonbrun, I. G. Speas, and W. E. Weathersby 29 Sep. 1966 60 p refs
(Contract W-7405-ENG-26)
(Y-1552) CFSTI: HC$3.00/MF$0.65

A study was made of the reuse of various types of organic oils and tri-aryl phosphate ester fluids used in large volume at the Oak Ridge Y-12 Plant. It was concluded that molecular sieve desiccant affords an economical means of obtaining highly purified stocks for reuse. A simple regenerative equipment arrangement has proved to be suitable for the purification of a wide range of lubricating, hydraulic, and insulating fluids. Author (NSA)

N67-17770*# Mechanical Technology, Inc., Latham, N. Y.
ON ERROR TORQUES OF SQUEEZE-FILM CYLINDRICAL JOURNAL BEARINGS
C. H. T. Pan and T. Chiang Jan. 1966 36 p refs
(Contract NAS8-11678)
(NASA-CR-76226; MTI-66TR2) CFSTI: HC $3.00/MF $0.65 CSCL 13K

Error torque and means of estimating its magnitude in squeeze-film bearing are presented. A cylindrical geometry is assumed for the bearing, and the squeeze frequency is assumed to be sufficiently large to permit an asymptotic analysis. Three types of tolerance effects are treated. Out-of-roundness of either the journal or the bearing or both make the bearing gap nonuniform even when the bearing is unloaded. A third tolerance effect is related to the squeeze motion; in the event of dissymmetry in either the structure or the mounting constraints or the presence of appendages attached to the transducer of the squeezed-film bearing, the squeeze motion may lose rotational symmetry. Among the conclusions drawn were that a first estimate of the error torque can be obtained by an asymptotic analysis considering perturbation effects of gap and excursion ellipticities; and that reduction of error torque without corresponding reduction in stiffness can be most effectively realized by absolute tolerance control. S.P.

N67-17823*# Westinghouse Electric Corp., Pittsburgh, Pa.
NASA CONTRIBUTIONS TO METAL JOINING
W. J. Reichenecker and J. Heuschkel Washington, NASA, 1967 141 p refs Sponsored by NASA
(NASA-SP-5064) GPO: HC $0.60; CFSTI: MF $0.65 CSCL 13H

A survey of reports on research in metals joining which has possible industrial applications is reported. Summarized are documents from 1962 to mid-1965 covering NASA sponsored

research in the metals joining field. The material reviewed is related to solving hardware problems and is not a treatise on the latest state of the art of metals joining. Included are data on novel tooling, process development and applications, base metal and filler metal relationships, and advances in understanding joining mechanisms. Cited are research on the following: nonwelding processes; welding processes; plasma spray bonding; light metals; refractory metals and vanadium; dissimilar metals joining and sealing; electronic component interconnections; and fracture testing. S.C.W.

N67-17831*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LUBRICATION AND WEAR FUNDAMENTALS FOR HIGH VACUUM APPLICATIONS
Robert L. Johnson and Donald H. Buckley Washington, NASA, 1967 42 p refs To be Presented at the Conf. on Lubrication and Wear Fundamentals and Appl. to Design, London, 25–28 Sep. 1967; Sponsored by Inst. of Mech. Engr.
(NASA-TM-X-52271) CFSTI: HC$3.00/MF$0.65 CSCL 11H

Summarized are basic observations of lubrication related phenomena in the vacuum environment. Included are data on vacuum technology, formation and degradation of lubricating films, cleavage studies of lubricating materials, adhesion of clean materials, and friction and wear phenomena. S.C.W.

N67-17885# Chase Brass and Copper Co., Inc., Waterbury, Conn.
FABRICATION OF ZIRCALOY-4 CLAD ZIRCONIUM-2.5 NIOBIUM PRESSURE TUBING
James L. Baker [1966] 21 p
(Contract AT(38-1)-412)
(Rept.-1; Rept.-2; Rept.-3; TID-23312) CFSTI: HC $3.00/MF $0.65

Work was performed on both short-trial and full-size billets to establish the feasibility of fabricating Zircaloy-4-clad Zr–2.5% Nb pressure tubing, using the extrusion and cold drawing process. The billets, produced by electron beam welding a Zircaloy-4 sleeve to the OD of Zr–2.5% Nb billets, were extruded to produce duplex shells with a metallurgical bond between the two alloys. An intermediate OD grinding was performed to reduce the nonuniformity in the clad, and measurements of the clad thickness were made. NSA

N67-17916# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOMECHANICAL PROCESSING OF STAMPINGS OF VT14 ALLOY
I. N. Kaganovich, Yu. I. Potapenko, and Ye. D. Igumenshchev 7 Dec. 1966 12 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 10, 1965 p 75–79
(FTD-HT-66-213; TT-67-60214; AD-643629) CFSTI: HC $3.00/MF $0.65

The purpose of this report was to explain the possibility of obtaining stable properties of goods from the VT14 alloy, prepared under conditions of series manufacture by thermomechanical processing. The use of thermomechanical processing with hot stamping improves the mechanical properties of the VT14 alloy, above all its plasticity. It raises the stability of the elongation factors, narrowing and impact viscosity. The increased plasticity of the VT14 alloy after thermomechanical processing appears to be the result of a greater dispersion of structural components, causing a greater number of possible sliding planes and doubling and a more uniform distribution of the same over the entire metal in the process of deformation or elongation. When evaluating the advisability of using thermomechanical processing, it is necessary to consider the reduced hardening of the VT14 alloy. In simple form details, when a high deformation degree is fulfilled, at a low temperature, the high properties can be assured at an ordinary stamping technology. Author (TAB)

N67-17938# General Dynamics/Convair, San Diego, Calif.
METALLURGICAL INVESTIGATION AND MECHANICAL PROPERTIES OF SPOT WELDED JOINTS CONTAINING CORROSION DEFECTS IN A CENTAUR AFT BULKHEAD-TANK 1D
Charles J. Kropp [1966] 36 p refs
(ZZL-66-008; AR-572-1-598)

Radiographs of the weld joints in the aft bulkhead of a scrapped Centaur tank (1D) were examined and several spot welds were cross-sectioned to determine the extent of the corrosion which was detected on the X-ray film. The results of this metallographic examination correlate very well with the results of a similar previous investigation. Other sections of weld joints from this bulkhead were then fabricated into test specimens and subjected to both a sustained load test and an ultimate tensile test at −320°F. As a result of the weld joint tests conducted and presented in this report, some information is made available concerning the effects that corrosion defects, present in the weld joints, may have on the mechanical properties of the joints when compared to defect-free joints. Author

N67-18039*# Rocketdyne, Canoga Park, Calif.
INVESTIGATION OF POSITIVE-TYPE SHAFT SEALS Interim Report, Jul. 1964–Dec. 1966
R. R. Hammond Nov. 1966 131 p
(Contract NAS8-11325)
(NASA-CR-81527; R-6811) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Several seal design concepts were examined in relation to expected future turbopump performance requirements. Of the three selected for fabrication and testing, the particle damped seal was shown to have the best damping characteristics. The welded metal bellows was selected as the secondary seal for all three designs, each having a different method of controlling the oscillatory motion of the bellows caused by the mechanical vibration and pressure pulsating environment of the turbopump. Tests indicate that the metal bellows design provides the most positive method of preventing secondary seal leakage, with a minimum number of potential leak paths. M.G.J.

N67-18046*# Hughes Aircraft Co., Culver City, Calif. Research and Development Div.
INVESTIGATION OF THE COMBINED EFFECTS OF SPACE ENVIRONMENT PARAMETERS ON SPACE VEHICLE MATERIALS Interim Summary Report, 1 Jul. 1965–30 Sep. 1966
C. A. Escoffery Oct. 1966 154 p refs
(Contract NAS8-20210)
(NASA-CR-81708; P66-227) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Details are presented of an environmental chamber designed and built to perform selected *in-situ* property measurements on materials exposed to a simulated space environment. The environment stresses include vacuum (10^{-9} torr), electrons, protons, and ultraviolet radiation. The test samples are disc-shaped specimens (up to twenty-five) mounted in suitable holders hinged along the rim of a turntable. The property measurements include

solar absorptance, dc resistivity, microwave permittivity (dielectric constant and loss tangent), and thermal diffusivity and conductivity.
Author

N67-18050*# Battelle Memorial Inst., Columbus, Ohio.
STUDY TO DETERMINE EXPERIMENTALLY THE FEASIBILITY OF NEW METHODS FOR IMPROVING THERMAL CONDUCTANCE OF MECHANICAL JOINTS IN A VACUUM Summary Research Report, 8 Apr.–30 Sep. 1966
C. L. Coffin, F. A. Creswick, and J. E. Sorenson 15 Dec. 1966 58 p refs
(Contract NAS8-20328)
(NASA-CR-81712) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An experimental program was conducted to evaluate the principle of two new methods for improving thermal conductance of mechanical joints in a vacuum, namely: (1) increasing actual contact surface area at the joint interface by plateauing the microscopic surface asperities, and (2) increasing the joint gross contact area by making one of the mating surfaces a flexible membrane pressurized by a thermally conducting paste or fluid. Results showed generally that surface-plateauing methods with metal-to-metal contact cause galling damage at the surface contact points. Ultrasonic-vibration techniques and pulsed-electric current heating with graphite tools neither damaged the surfaces nor plateaued the asperities. Analysis indicated that unless a fluid with high thermal conductivity can be found, the utility of the flexible-surface diaphragm as a means to increase joint thermal conductance is questionable. This report describes the experimental program, discusses machined-surface characteristics, thermally conductive fluids, surface plateauing considerations, and flexible-membrane design considerations; and presents the conclusions and recommendations resulting from this investigation.
Author

N67-18053*# Boeing Co., Seattle, Wash. Aerospace Group.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Progress Report, 11 Oct. 1966–11 Jan. 1967
11 Jan. 1967 49 p refs
(Contract NAS7-276)
(NASA-CR-81526; PR-11) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Several sets of canned ceramic billets were successfully extruded. Analysis of these billets is consistent with previous observations and supports the hypothesis that thermal stress is more important than surface shear in causing cracking. Further success in reducing cracking was achieved by again slowing cooling and by use of smaller billets. Initial comparison shows that starting orientation has little or no effect on extruded orientation. The successful extrusion of an insulating can consisting of alternate tungsten and MgO layers with MgO billets indicates that extrusion heating temperature may be lowered to reduce grain size, thus further increasing strength. This extrusion was also instrumented with thermocouples which indicate that previous measurements based on optical readings at the rear of the can may be low by 100°C or more. This would explain difficulties observed in recent extrusions and the odd behavior of Al_2O_3 extrusions.
Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-16725*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HYDROGEN MASER RESEARCH ACHIEVEMENTS AT MSFC
John G. Gregory *In its* Commun. Systems Res. at MSFC 1966 p 1–8 refs (See N67-16724 07-07) CFSTI: HC $3.00/MF $0.65

The basic principles and the construction of a hydrogen maser and its potential as a highly stable frequency reference for precision tracking systems are discussed. Improvements in stability and size are presented and future improvements are proposed. Results of measurements of relative frequency stability of two masers and the comparison of a hydrogen maser and a cesium beam are discussed. Also presented is the status of the hydrogen maser program and possible areas of application.
Author

N67-16952# Air Force Missile Development Center, Holloman AFB, N. Mex. Central Inertial Guidance Test Facility.
REAL TIME TEM-MODE ANALYSIS OF He–Ne LASERS
Ferdinand F. Kuhn *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 38 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

This paper describes a unique device referred to as "Automatic Laser Beam Detector and Real Time Transverse Electro-Magnetic Mode (TEM-MODE) Analyzer" that has the following novel features: (a) It permits the optimal tuning of any continuous wave (CW) laser without exposing the investigator to the dangers of looking directly at the laser beam or its reflection. (b) It avoids possible ambiguities in distinguishing between various TEM-modes by its ability to move by remote control the light sensing pinhole/photo-diode combination with respect to the center of the scanning motion of the laser beam. (c) It allows the continuous observation of laser power output changes as a result of TEM-mode transitions. (d) It permits the continuous observation and the tuning of a CW Laser for optimal purity. Several illustrative examples of actual results are presented.
Author

N67-16954# Air Force Cambridge Research Labs., Bedford, Mass.
LASER BRIGHTNESS GAIN AND MODE CONTROL BY COMPENSATION FOR THERMAL DISTORTION
C. Martin Stickley *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 31 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

Laser rod beam divergence is compensated for by means of an external mirror having a curvature opposite to that induced in the rod. The distortion produced in the rod is described in terms of a ray matrix of a thick lens whose focal length is a function of the input energy to the rod. After compensating an excellent optical quality rod with an external mirror a brightness gain of about 100 was achieved simultaneously with single transverse mode operation (TEM_{00}) at pump energies as high as 40% over threshold. This procedure for achieving single transverse mode operation is advantageous since (a) no extra elements are needed in the cavity; (b) the beam divergence is near the diffraction limit for the rod holder; and (c) the TEM_{00} mode is not only selected but enhanced in volume, thus increasing the power output in this mode and the mode stability of the laser.
Author

N67-17168*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A TRAVELING WAVE MASER FOR DEEP SPACE COMMUNICATION AT 2296 AND 2388 MHz
R. C. Clauss 15 Feb. 1967 20 p refs
(Contract NAS7-100)
(JPL-TR-32-1072) CFSTI: HC $3.00/MF $0.65 CSCL 20E

A tunable traveling wave maser has been used for deep space communications at 2295 MHz and for planetary radar at 2388 MHz. Machining techniques that enable a comb-structure maser to be fabricated from a single piece of copper have been

developed. Excellent surface finish and close tolerances result in low loss at the signal frequency. Coupling and loading techniques are described. Gain adjustment trim coils are used to trade gain for additional bandwidth. An external overcoupled cavity is used with the pump klystron to provide pump power for operation at a signal frequency of either 2295 or 2388 MHz. The maser operates in a closed-cycle helium refrigerator at 4.4°K, and refrigeration is also used to cool the signal input coaxial transmission line. An in-line quarter-wave thermal short circuit is used to transfer heat from the coaxial center conductor. This has reduced the equivalent input noise temperature of the maser to 5°K. Author

N67-17169# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED SPECTROSCOPY Selected Articles
31 Aug. 1966 18 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 3, no. 3, 1965 p 225–229, 279–282
(FTD-HT-66-310; TT-66-62244; AD-638973) CFSTI: HC $3.00/MF $0.65

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1. OPERATION OF A RUBY LASER WITH INCLINED MIRRORS V. L. Broube and V. V. Zaika p 1–9 refs (See
2. THE MECHANISM OF RADIOLUMINESCENCE OF ALKALI–HALIDE PHOSPHOR CRYSTALS T. A. Soovik p 10–16 refs (See N67-17171 07-26)

N67-17170# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPERATION OF A RUBY LASER WITH INCLINED MIRRORS
V. L. Broube and V. V. Zaika *In its* J. of Appl. Spectry 31 Aug. 1966 p 1–9 refs (See N67-17169 07-16) CFSTI: HC $3.00/MF $0.65

Features of the operation of ruby laser with flat mirrors inclined at an angle of 3'–10' are investigated. It is shown that the slope of the mirrors causes a shift in the intensity maximum on the mirrors and divergences of the radiation beams to the far edges of the mirrors. Correspondence is then observed between images in the near and far zones for any directions of inclination of the mirrors. Experimental results are compared with theoretical deductions, and conclusions are drawn on the mode composition of radiation. Author

N67-17274 Baird-Atomic, Inc., Cambridge, Mass.
RESEARCH ON CIRCULARLY POLARIZED LASERS AND THEIR USE Final Report
A. W. Hornig 31 Jul. 1966 70 p refs
(Contract AF 49(638)-1167)
(AFOSR-66-2679; Rept.-5263-FR; AD-642406)

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1. LASER OPERATING IN CIRCULARLY POLARIZED MODE p 1–5
2. USE OF CIRCULARLY POLARIZED LASER LIGHT TO INVESTIGATE PROPERTIES OF GYROTROPIC MEDIA p 6–11 refs

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3. THE EFFECT OF REFLECTING SURFACES ON THE POLARIZATION STATE OF A LIGHT BEAM A. F. Quesada 14 p refs (See N67-17275 07-16)
4. ANALYSIS OF FOUR-MIRROR RESONANT CAVITY A. F. Quesada 11 p (See N67-17276 07-16)
5. CIRCULARLY POLARIZED LASER MODES IN RUBY J. Kaplan and J. Goldstein 7 p refs (See N67-17277 07-26)
6. APPLICATION OF THE SENARMONT POLARISCOPE TO ANALYSIS OF OPTICAL MASER LIGHT D. Hellerstein 5 p refs (See N67-17278 07-16)
7. ALIGNMENT OF Cr^{3+} IN RUBY G. F. Hull, Jr., J. T. Smith, and A. F. Quesada 4 p refs (See N67-17279 07-26)

N67-17275 Baird-Atomic, Inc., Cambridge, Mass.
THE EFFECT OF REFLECTING SURFACES ON THE POLARIZATION STATE OF A LIGHT BEAM
A. F. Quesada 23 Jul. 1962 *In its* Res. on Circularly Polarized Lasers and Their Use 31 Jul. 1966 14 p refs (See N67-17274 07-16)

Effects of various types of reflecting surfaces on the polarization state of a light beam is considered, and the phenomenon is described in terms of the Stokes' parameters. A reflecting element is regarded as a combination of a dichroic element and a retardation plate with coincident axes, whose direction is determined by the plane of incidence. The amount by which each component of the incident beam is attenuated, as well as the relative phase shift introduced on reflection, depend on the nature of the reflecting surface and the magnitude of the angle of incidence. The first of two reflecting elements considered is a metallic surface, and the second type is a prism of similar device making use of the phenomenon of total reflection at one or more of its faces. S.P.

N67-17276 Baird-Atomic, Inc., Cambridge, Mass.
ANALYSIS OF A FOUR-MIRROR RESONANT CAVITY
A. F. Quesada 23 Apr. 1963 *In its* Res. on Circularly Polarized Lasers and Their Use 31 Jul. 1966 11 p (See N67-17274 07-16)

Light reflection and transmission are analyzed in terms of a four-mirror cavity constituted by mirrors directly facing each other so as to form a square. Optical path differences and lengths are computed for rays reflected from each of the mirrors. Intensities and amplitudes of internal and external fields are also calculated for these beams. S.P.

N67-17278 Baird-Atomic, Inc., Cambridge, Mass.
APPLICATION OF THE SENARMONT POLARISCOPE TO ANALYSIS OF OPTICAL MASER LIGHT
David Hellerstein *In its* Res. on Circularly Polarized Lasers and Their Use 31 Jul. 1966 5 p refs Repr. from Appl. Optics, v. 2, no. 8, Aug. 1963 p 801–805 (See N67-17274 07-16)

A Senarmont polariscope suitable for optical maser work has been constructed. It employs an optically active wedge and an analyzing polarizer to map the azimuthal angle onto a linear field, indicating this angle by null positions on a photographic plate. It measures the azimuth of linearly polarized light over a range of 180° with an accuracy at present of ±1.5° and distinguishes between right and left circularly polarized light. This device is compact and relatively inexpensive; it requires no auxiliary electronic apparatus. Author

N67-17358*# Aircraft Armaments, Inc., Cockeysville, Md.
FM MODULATION OF A CW LASER BEAM
Washington, NASA, Feb. 1967 refs
(Contract NAS5-9660)
(NASA-CR-668) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Frequency modulation and demodulation methods for CW lasers are analyzed in terms of amplitude noise sensitivity. Expressions

are derived for detector noise limited signal to noise performance. Results of experiments performed with homodyne, optical discriminator and heterodyne detection breadboards are reported. An experimental transmitted reference heterodyne detection, angle modulated system is described. The modulator utilizes a 45 degree Y cut ADP crystal with length to thickness ratio of 8. Performance of the experimental breadboard over a 300 meter turbulent atmospheric path indicates that the angle modulated transmitted reference heterodyne system is insensitive to atmospherically induced noise fluctuations. Improvements in laser frequency stability are indicated to permit evaluation of broadband modulation capability. Author

N67-17362 National Bureau of Standards, Boulder, Colo.
LASERS
In its Conf. on Precision Electromagnetic Meas. 1966 p 6–17 (See N67-17361 07-14) CFSTI: HC $3.00/MF $0.65

Summaries are presented of conference papers which cover the state of the art and possible applications of lasers. Specific topics include: (1) aspects of fringe counting in laser interferometers, (2) interferometric measurements on diffuse surfaces by holographic techniques, (3) noise in lasers and laser detectors, (4) radiometric measurement of laser output, (5) calorimetric measurement of pulsed laser output energy, (6) a laser microcalorimeter, and (7) frequency stabilization of gas lasers. A.G.O.

N67-17788*# Massachusetts Inst. of Tech., Cambridge.
APPLICATION OF LASER RADARS TO THE STUDY OF THE ATMOSPHERE
Giorgio Fiocco *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 123–131 refs (See N67-17781 07-14) GPO: HC $1.00; CFSTI: MF $0.65

Several experiments are discussed in which lasers were used in developing optical atmospheric probes capable of measuring some atmospheric parameters at a distance. Identified as the simplest experiments to perform are those related to the measurement of the optical backscattering cross section of the atmospheric constituents as a function of range. Details are given on studies of the temporal variation of the dust content of the lower stratosphere, and of noctilucent clouds. Also discussed is the development of devices with the capability of measuring such kinetic parameters as wind velocity and gas temperatures. The technique, in principle, aims at measuring the bulk shift and broadening of the spectral line of the scattered radiation due to the Doppler effect caused by the radial component of the molecular variety. A possible ideal scheme for a homodyne optical radar is proposed. The possibility of separately obtaining echoes from different atmospheric gases by differentiating or enhancing their spectral scattering characteristics is considered as another application for these techniques. M.G.J.

N67-17906# Naval Ordnance Lab., White Oak, Md.
TIME RESOLVED STUDIES OF LASER-INDUCED PLUMES FROM SOLIDS Final Report
Bernard V. Kessler and Charles E. Bell 9 Sep. 1966 31 p refs (NOLTR-66-96; AD-643509) CFSTI: HC $3.00/MF $0.65

Time-resolved and time-integrated measurements were made of the plasma produced by a Q-switched laser beam focused on the surface of a metallic solid. Photographic, spectroscopic and charged particle emission data were taken on a nanosecond basis using a one megawatt peak power Nd laser. Experimental results indicate a plume velocity of 2.5cm/microsec., a plasma temperature of 40,000K and an electron density of 5 x 10 to the 17th power/cc. It was also found that it requires 6-10 nanoseconds for a laser beam to penetrate a thin metal foil. Author (TAB)

N67-17910# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SESSIONS OF THE SECTION ON GENERAL AND APPLIED PHYSICS
N. V. Karlov 27 Sep. 1966 7 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 8, 1965 p 82–84 (FTD-HT-66-458; TT-67-60232; AD-643875) CFSTI: HC $3.00/MF $0.65

The article describes a group of reports given on quantum electronics and the results and prospectives of the work conducted at the Oscillation Laboratory of the Physics Institute is analyzed. TAB

N67-18019*# Stanford Univ., Calif. Microwave Lab.
INVESTIGATION OF LASER DYNAMICS, MODULATION AND CONTROL BY MEANS OF INTRA-CAVITY TIME VARYING PERTURBATION Semiannual Status Report No. 2, 1 Aug. 1966–31 Jan. 1967
S. E. Harris Jan. 1967 9 p refs
(Grant NGR-05-020-103)
(NASA-CR-81730; ML-1502) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Continuing work on the argon FM laser, parametric generation at optical frequencies, and backward wave oscillation in the far infrared are reported. A single frequency output power of 350 mW of single frequency light at 5145 Å was obtained with the argon laser with a distortion of less than 0.2%. The effect of power dependent homogeneous broadening on the distortion in the FM laser was emphasized, and it was determined that as the power is increased, the distortion of the oscillation is reduced. Experiments relating to the construction of an optical parametric oscillator wherein the nonlinear material is situated internally to the cavity of the pumping laser, and testing $LiNbO_3$ crystal for use as the nonlinear element are described. Progress in the backward wave oscillation program included debugging and stabilization of the high power Q-switched ruby laser, construction of a Dewar system for possible operation at liquid helium temperatures, and measurement of birefringence as a function of temperature in a $LiTaO_3$. N.E.N.

N67-18023*# Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
LASER/OPTICS TECHNIQUES Second Interim Summary Report
Morley S. Lipsett 31 Dec. 1966 68 p ref
(Contact NAS8-20115)
(NASA-CR-81701; Rept.-8631) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The development of transmit beam offset and coarse acquisition equipment for the Laser/Optics Techniques breadboard is described. In addition, preliminary acquisition and track simulation experiments carried out in the laboratory with the breadboard hardware are discussed. Author

N67-18113# Joint Publications Research Service, Washington, D. C.
CONCERNING THE USE OF HIGHLY IONIZED PLASMA TO CREATE A LASER
L. I. Gudzenko, V. N. Kolesnikov, N. N. Sobolev, and L. A. Shelepin 25 Jan. 1967 5 p refs Transl. into ENGLISH from Magnitnaya Gidrodinamika (Riga), no. 3, Jul–Sep. 1965 p 54–56 (JPRS-39659; TT-67-30308)

Development of an optical quantum generator from a highly ionized low temperature plasma is discussed as a means of converting heat energy into both electrical and coherent light radiation energies. Two general methods are discussed for the abrupt cooling of the free electrons of the highly ionized, low temperature plasma.

One method utilizes heavy particles of ions and neutral atoms of the plasma itself; the other uses the walls of the vessel as the cooling agent. Experiments are also being conducted on the use of magnetohydrodynamic cooling methods in which there is considerable separation of the electron temperature from that of the heavy particles; and such methods are considered applicable to the development of a new-type laser. M.W.R.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-16767# Pennsylvania Univ., Philadelphia. School of Metallurgical Engineering.

VACANCY CLUSTERS AND MECHANICAL PROPERTIES AS DETERMINED FROM QUENCHING STUDIES

R. Maddin and H. Kimura (Tohoku Univ.) *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 503–520 refs Sponsored by ONR (See N67-16751 07-26) HMSO: 48s

A review is presented of the state of understanding concerning the relation among vacancy aggregates, their condensation products, and mechanical properties as determined by studies of quench hardening phenomena. Studies on hardening due to loops, void hardening, and hardening due to jogs are discussed. Areas of needed research are outlined. R.N.A.

N67-16768# Naval Ordnance Test Station, China Lake, Calif. Research Dept.

THE FLOW STRESS TEMPERATURE DEPENDENCE OF SECONDARY DEFECTS

K. H. Westmacott *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 521–538 refs (See N67-16751 07-26) HMSO: 48s

The paper summarizes some experimental results obtained as part of a program aimed at isolating and characterizing the hardening (specifically, the flow stress) associated with various secondary defects in aluminium. New techniques are used which permit the measurement of yield or flow stress and microstructural evaluation by electron microscopy to be performed on the same specimen. The importance of this procedure is demonstrated by the behavior of quenched aluminium in which the form of the yield stress temperature dependence varies markedly with the type and distribution of the secondary defects. Author

N67-16769# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.

ELECTRON IRRADIATION HARDENING AND THE INTERSTITIAL-DISLOCATION INTERACTION IN ALUMINUM

Kanji Ono (Calif. Univ., Los Angeles) and M. Meshii *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 539–549 refs (See N67-16751 07-26) HMSO: 48s

(Contract AT(11-1)-1367)

Results are presented of an investigation in which electron irradiation was used to introduce dispersed point defects into aluminum single crystals. Pairs of a vacancy and an interstitial were produced randomly as a result of the electron-nucleus collisions. Information on the nature of point defect hardening was obtained by studying various mechanical properties of the irradiated specimen, such as yield stress, work hardening behavior, and strain-rate and temperature dependence of the yield or flow stress. R.N.A.

N67-16770# Ludwig-Maximilians-Universistat, Munich (West Germany). Physikalisches Institut.

EXPERIMENTS CONCERNING THE CRITICAL SHEAR STRESS OF N-IRRADIATED METALS

Ch. Schwink and N. Neuhaeuser *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 550–564 refs (See N67-16751 07-26) HMSO: 48s

The effect of lattice defects produced by fast neutrons on the flow stress of Cu crystals was investigated. Three experiments and their results are described which are thought to be important for any theoretical interpretation. In these experiments, Cu single crystals of medium orientation, 4 mm in diameter and 60 mm in length, were irradiated in a research reactor to a total dose of about 2×10^{18} nvt. R.N.A.

N67-16771# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

THE CORRELATION BETWEEN THE CRITICAL SHEAR STRESS OF NEUTRON IRRADIATED COPPER SINGLE CRYSTALS AND THE DENSITY OF DEFECT CLUSTERS

M. J. Makin, F. J. Minter, and S. A. Manthorpe *In its* Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 565–592 refs (See N67-16751 07-26) HMSO: 48s

The relationship between the density of defect clusters, as observed by transmission electron microscopy, and the critical shear stress of single crystals during the annealing of neutron irradiated copper has been experimentally determined. Single crystals and foil specimens were irradiated together for the same dose and examined after annealing for various times at 270°, 306° and 336°C. A single linear relationship was found between the critical shear stress at 4.2°K and the square root of the density of clusters less than 50Å in diameter after anneals at all of the three temperatures. For the large clusters, which are thought to be interstitial loops, linear relationships were not obtained and the results for the three annealing temperatures did not coincide. This work suggests that irradiation hardening is almost entirely due to the small clusters and the average value of the resistance F_{max} of each cluster is not less than 1.25×10^{-4} dynes. To explain the results obtained at different testing temperatures it is concluded that clusters of different size are present which all have the same F_{max}. Author

N67-16961# Air Force Systems Command, Kirtland AFB, N. Mex. Weapons Lab.

ULTRASONIC STUDIES OF 1060 AND 6061-T6 ALUMINUM

James R. Asay and Arthur H. Guenther *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 31 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

An ultrasonic pulse echo technique has been used to measure the longitudinal and shear velocities at ambient pressure in two aluminum alloys, 1060 and 6061-T6. Measurements were made from 25°C to ≈ 200°C to determine the temperature dependence of the elastic constants. A Gruneisen ratio is calculated from the experimental data which is used in conjunction with the Murnaghan logarithmic representation of the equation of state to estimate the specific volume to ≈ 450 kbars. Data are also presented regarding the pressure dependence of the various modes of propagation, as

obtained in a uniaxial stress technique. The applied uniaxial stress ranged from ambient to ≈11,000 psi for 6061-T6, and to ≈3,000 psi for 1060 AL. Author

N67-17020# Library of Congress, Washington, D. C. Aerospace Technology Div.
THE STRUCTURE AND PROPERTIES OF HEAT-RESISTANT ZhS-TYPE NICKEL ALLOY DURING COOLING Translations of Foreign Scientific and Technical Literature
V. V. Gayduk, A. D. Kobal, and B. S. Natalov 25 Aug. 1966 10 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 5, 1966 p 20–22
(ATD-66-105; TT-67-60034; AD-642265) CFSTI: HC $3.00/MF $0.65

The purpose of this study was to follow the structural changes which occur in cast ZhS alloy during rapid cooling from various temperatures, to study the effect of annealing temperatures on rupture strength and notch toughness, to investigate the dissolution kinetics of secondary phases in solid solution on heating, and to determine the fields of application of various heat treatment conditions in practice. Research was conducted with a nickel-base heat-resistant alloy (0.1% C, 16.2% Cr, 4.9% W, 4.4% Mo, 4% Fe, 2.9% Al, 2.4% Ti, 0.4% Si, 0.5% Mn, 0.02% B, 0.015% Ce) melted in a vacuum induction furnace. The authors found that the optimum structure and best properties of the alloy are insured by annealing at 1200C. However, the surface damage which can occur on heating in air necessitates considerable machining (not less than 0.3 mm). The most stable structure is achieved by double heat treatment: annealing followed by rapid cooling and aging. Author (TAB)

N67-17034# Army Materials Research Agency, Watertown, Mass.
STRAIN RATE, STRAIN, AND TEMPERATURE RELATION TO ANISOTROPY IN H11 STEEL
Robert M. Colton and Gabriel J. Enyedy Oct. 1966 15 p refs
(AMRA-TR-66-31; AD-642398) CFSTI: HC $3.00/MF $0.65

The anisotropy of a metal has been found to be a critical factor in deep-drawing operations. Further, it has been found that the anisotropy present in as-received metal can be accentuated or retarded to some degree by varying certain drawing parameters. Variation of each of these parameters produces a different effect on the anisotropic behavior of the material. In this study, the effect of total strain, strain rate, and material temperature on the anisotropy of H11 tool steel (5 percent Cr) are presented as evidence of this manifestation. Author (TAB)

N67-17089 General Dynamics/Convair, San Diego, Calif.
THE SUSCEPTIBILITY OF K-MONEL TO HYDROGEN EMBRITTLEMENT
R. W. Tryon and J. B. Steinman Jan. 1966 20 p refs
(ZZL-65-027; AR-572-1-572)

A test program was performed to determine the susceptibility of K-Monel to hydrogen embrittlement. Tensile, notched tensile, and bend properties were determined on "as received" and on "charged" K-Monel test specimens. The test data indicated little effect on the tensile and notched tensile properties of K-Monel in either the annealed or aged conditions as a result of cathodically, hydrogen charging in a salt water environment. However, a significant decrease in the bend ductility of aged K-Monel resulted from hydrogen charging. Limited tests on Type 301 stainless and 4340 steels were performed for comparison. It is concluded from this program that 4340 and 301 steels are definitely susceptible and that K-Monel, under certain conditions, is susceptible to hydrogen embrittlement. Author

N67-17098 General Dynamics/Convair, San Diego, Calif.
STRESS–STRAIN CHARACTERISTICS OF 321 STAINLESS STEEL (ANNEALED) AT ROOM AND CRYOGENIC TEMPERATURES
W. E. Witzell Mar. 1966 16 p refs
(ZZL-66-013; AR-572-1-603)

Centaur Stress Group was concerned about the behavior of Type 321 stainless steel (annealed) above its yield strength. This concern was intensified by the report that complicated oscillations (or serrations) occurred in the stress–strain curve at −423°F between the yield and ultimate strengths of the material. Specimens were fabricated from 0.080" and 0.020" (nominal) sheet and tested at 75°F, −320°F, and −423°F using extensometers, strain gages, and deflectometers. No serrations were observed at any temperature for either thickness of this material. Subsequent reports showed the serrations were found in round bar stock 3/4" in diameter, but not in thinner sheet stock. Stress–strain curves were obtained and are presented in this report. Author

N67-17241# Lehigh Univ., Bethelem, Pa. Inst. of Research.
STUDY OF THE EFFECT OF SOLIDIFICATION STRUCTURES ON THE STRENGTH OF METALS Quarterly Progress Report, May–Jul. 1966
R. W. Kraft and R. W. Hertzberg Aug. 1966 10 p refs
(Contract DA-36-038-AMC-2732(A))
(QPR-4; AD-642238) CFSTI: HC $3.00/MF $0.65

Ingots of the Al_3Ni–A_1 eutectic were unidirectionally solidified, hydrostatically extruded by amounts up to 60%, and tensile properties evaluated. Tensile strengths up to 36,700 psi with 2.25% elongation at maximum load (total elongation over 3.0%) were obtained on specimens with an initial colony microstructure. Analysis of the data, while still incomplete, indicates that one or more extrusion variables can have effects of the same order of magnitude as the microstructural variables of the material being studied. In the other phase of the research on light-metal alloys (i.e. Mg base eutectics) tensile data was obtained on undirectionally solidified specimens of all alloys under investigation. Compression tests were run to obtain a more reasonable evaluation of the intrinsic strength of these alloys, all of which are rather brittle. Further evidence that the alloys are behaving as reinforced composites is given by the fact that the tensile stress-strain curves usually have the shape expected from anisotropic two phase composites. It should be noted that the tensile strengths observed are as high as any cast magnesium base alloy known to the authors and that the compressive strengths, on the strength to density ratio, range up to 975,000 in. This latter property may be attractive in certain ballistic applications. Author (TAB)

N67-17391# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDIES OF STEELS AND ALLOYS Selected Articles
30 Jun. 1966 22 p refs Transl. into ENGLISH from the Book "Issledovaniya Staley i Splavov" Moscow, Izd. Nauka, 1964 p 114–117; 166–171
(FTD-MT-65-383; TT-66-62495; AD-640724) CFSTI: HC $3.00/MF $0.65

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1. PLASTICITY AND STRENGTH OF TUNGSTEN DURING SHORT TIME TESTS V. P. Severdenko and R. M. Kal'nitskiy p 1–7 refs (See N67-17392 07-17)

2. INFLUENCE OF WORKING TEMPERATURES ON PROPERTIES OF ALLOY E1-437 V. I. Prosvirin, A. I. Zaytsev, and V. D. Mortikov p 9–17 refs (See N67-17393 07-17)

N67-17392# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASTICITY AND STRENGTH OF TUNGSTEN DURING SHORT TIME TESTS
V. P. Severdenko and R. M. Kal'nitskiy *In its* Studies of Steels and Alloys 30 Jun. 1966 p 1–7 refs (See N67-17391 07-17) CFSTI: HC$3.00/MF$0.65

Preliminary deformation of cermet tungsten was carried out in a 20–1000°C temperature and a $2.36 \cdot 10^{-2}$ to $5.55 \cdot 10^{-1}$ sec^{-1} speed range, in order to determine its plasticity and strength. Equations were derived to show the magnitude of deformation brought to the linear diagram of stress condition. It was found that plasticity increased with an increase of test temperatures, but strength decreased at higher temperatures. R.Li.

N67-17393# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF WORKING TEMPERATURES ON PROPERTIES OF ALLOY EI-437
V. I. Prosvirin, A. I. Zaytsev, and V. D. Mortikov *In its* Studies of Steels and Alloys 30 Jun. 1966 p 9–17 refs (See N67-17391 07-17) CFSTI: HC$3.00/MF$0.65

To investigate heat-resistant alloys for engine application, alloy EI-437 was hardened from 1080° for 8 hours and tempered at 700° for 16 hours. Experimental results indicate that Alloy EI-437 in the heat-treated state does not possess a stable structure during prolonged (600–800 hours) heatings in the 550–700° range, which causes change of mechanical properties. Prolonged heating at 700° increases hardness of alloy, but resiliance is decreased. Ultimate strength, yield point, elongation per unit length, and reduction of area at 20° increase somewhat during time of holding. Plasticity is noticeably decreased and rupture strength lowered. R.Li.

N67-17400*# National Aeronautics and Space Administration, Washington, D. C.
A SURVEY OF FATIGUE THEORY [OBZOR TEORIY USTALOSTI]
V. S. Ivanova Nov. 1966 24 p refs Transl. into ENGLISH from the Publ. "Sbornik Ustalnost' Metallov" Moscow, Akad. Nauk SSSR 1958 p 3–18
(NASA-TT-F-10392) CFSTI: HC$3.00/MF$0.65 CSCL 11F

A survey is presented of fatigue theories. Fatigue theories based on the concept of strain hardening, which followed, did not reflect the specific feature associated with the mechanism of fatigue failure, i.e., did not reflect the difference in failure observed during the action of static and cyclic loading. Fatigue theories of hardening and softening producing metal disintegration under conditions of cyclic loads served as a further step ahead in the study of the fatigue failure of metals. Subsequent work revealed the importance of taking into account the increase in the resistance to plastic deformation and the decrease in breaking strength in the development of fatigue failure. The statistical theory of fatigue made it possible to explain the laws which reflect the effect of various factors, particularly of the scale effect, on fatigue criteria. Author

N67-17422# Oak Ridge National Lab., Tenn.
SOLUTIONS TO THE PROBLEMS OF HIGH-TEMPERATURE IRRADIATION EMBRITTLEMENT
W. R. Martin and J. R. Weir Jun. 1966 29 p refs Presented at the 69th Ann. Meeting of the Am. Soc. for Testing and Mater., Atlantic City, 27 Jun.–1 Jul. 1966
(Contract W-7405-ENG-26)
(ORNL-TM-1544; CONF-660627-1) CFSTI: HC$3.00/MF$0.65

The effect of irradiation on the high-temperature mechanical properties of structural materials is described using type 304 stainless steel as an example. The general effect is one in which the grain-boundary fracture process, but not the deformation process, is affected. The data suggest the primary cause to be He generated from (n,α) reactions. Several metallurgical techniques for improving the ductilities of irradiated alloys are suggested and experimental data on type 304 stainless steel are given for which the degree of improvement is demonstrated. Author (NSA)

N67-17432# Los Alamos Scientific Lab., N. Mex.
STABILITY OF DELTA-PHASE PLUTONIUM–GALLIUM ALLOYS
W. N. Miner [1966] 23 p Presented at the 7th Semiann. Meeting of the Plutonium Weapons Inform., Livermore, Calif.
(Contract W-7409-ENG-36)
(LA-DC-7934; CONF-660551-1) CFSTI: HC$3.00/MF$0.65

A summary is presented concerning a program in which 90 specimens of Pu containing from 0.1 to 1 wt % Ga were subjected to a variety of conditions and several thermal treatments at −194° to +100°C. Density measurements were used as an index to phase stability along with dilatometry, metallography, and chemical analysis. Conclusions concerning parameters of delta-phase stability in these alloys are included. NSA

N67-17446# Atomics International, Canoga Park, Calif.
CALCULATION OF WEIGHT GAIN IN GAS–METAL REACTIONS
W. A. Young 14 Jun. 1966 42 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11967) CFSTI: HC$3.00/MF$0.65

A computer program is described for calculation of the change in weight of a metal as a consequence of reaction with a gas such that a product film is formed; the reaction need not occur under isothermal conditions. The program is written in FORTRAN IV for use with IBM-7090/7094 or systems 360 computers. The output consists of tabulated weight gain versus time and temperature and, if desired, graphic display (SC-4020 equipment) of weight versus time, temperature versus time, and/or weight versus temperature. Author (NSA)

N67-17469# Oak Ridge National Lab., Tenn.
RADIATION METALLURGY SECTION, SOLID STATE DIVISION Progress Report, Period Ending Jul. 1966
Sep. 1966 64 p refs
(Contract W-7405-ENG-26)
(ORNL-4020) CFSTI: HC$3.00/MF$0.65

Investigations on the response of weld heat-affected-zone samples of ASTM A-212B pressure-vessel steel reveal that heat-affected-zone samples show a higher ductile-brittle transition temperature after irradiation and are less responsive to post-irradiation annealing that base plate specimens. Studies of the effect of neutron irradiation and post irradiation annealing on the tensile properties show that annealing of radiation hardening takes place at 300 to 600°C. An analysis was developed to determine the ductile-brittle transition temperature of metals in terms of experimentally obtainable grain size parameters. Results of stress–strain tests on Ferrovac-E specimens after neutron irradiation at 55 to 90°C suggested that radiation hardening may be viewed as equivalent to strain hardening. Dislocation tangles form in Ferrovac-E at lower strains in irradiated specimens that in unirradiated specimens; these may be a consequence of dislocation channeling. The effect of specimen purity on the flow stress of Nb single crystals was studied using tensile specimens cut from rods given

various numbers of zone refining passes. For Nb prepared from Wah Chang starting stock the lower yield shear stress dropped from 2.5 kg/mm^2 after 1 pass to 1.6 kg/mm^2 after 4 passes. Further numbers of passes up to 12 caused little change in the flow stress. Similar effects were observed using DuPont Nb starting material. The effect of neutron irradiation on the plastic deformation of Nb single crystals is being studied. Results indicate that the dislocation velocity at the upper yield point is about the same in both unirradiated Nb and irradiated Nb. It was also found that the dislocation velocity at the lower yield stress is a factor of six greater in irradiated Nb than in unirradiated Nb, and that the mobile dislocation density at the lower yield stress is a factor of six less in the irradiated Nb than in the unirradiated Nb. Nb containing O, N, and C as interstitial impurities was irradiated at 50°C, and then annealed. Internal friction measurements showed that upon warming the O interstitials which are the most mobile of the three species migrate to radiation produced defects and are effectively removed from the normal lattice sites. It was concluded that this process is responsible for the stage III changes of resistivity and yield stress. Progress towards completion of the design of a fission flux neutron convertor irradiation facility is described. NSA

N67-17489# California Univ., Berkeley. Lawrence Radiation Lab.
DECOMPOSITION OF CHROMIUM-TUNGSTEN SOLID SOLUTION
David Porter (Ph.D. Thesis) Jan. 1966 54 p refs
(Contract W-7405-ENG-48)
(UCRL-16619) CFSTI: HC $3.00/MF $0.65

The mechanism of solid-solution decomposition within the chemical spinodal boundary was investigated for the W–Cr system. Two alloys were solution-treated, quenched, and aged at various temperatures inside the chemical spinodal boundary. It was concluded from X-ray and metallographic evidence that W–Cr alloys do not decompose by a spinodal mechanism. The decomposition process was found to be one of nucleation and growth. A theoretical analysis provided answers that explain the behavior of this alloy system. Author (NSA)

N67-17498# Chantiers de l'Atlantique Penhoet-Loire, Paris (France).
THE AUSTENITISATION OF PM 24 STEEL
19 Apr. 1966 16 p refs Transl. into ENGLISH from French Spec. Rept.-15
(Contract EURATOM-054-61-12 RDF)
(EURAEC-1686; EUR-2873) CFSTI: HC $3.00/MF $0.65

Results of the investigation indicate that austenitization at 900°C leads to refining of the grain (for rates between 2 and 1000°C/min) whatever the cooling rate after super-heating. However, if specimens cooled slowly after super-heating are reheated to 1000°C, it is found that some super-heated grain zones are regenerated at 900°C (no refining is found). No appreciable modification of the ferritic structure after cooling at 5°C/min from 900°C was found. The regeneration of PM.24 steel after super-heating leads to a homogeneous fine grained steel. NSA

N67-17515*# National Aeronautics and Space Administration, Washington, D. C.
STRUCTURE OF ALLOYS OF THE Zr–C–Nb SYSTEM [STROYENIYE SPLAVOV SISTEMY Zr–C–Nb]
S. S. Ordan'yan, A. I. Avgustinik and V. Sh. Vigdergauz Dec. 1966 9 p refs Transl. into ENGLISH from Zh. Prikl. Khim. (Moscow), v. 39, no. 2, 1966 p 312–317
(NASA-TT-F-10493) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An isothermal section was constructed at 2273°K as a result of investigation into the alloys of the Zr–C–Nb system. No triple compounds were discovered; there are three single-phase fields, three two-phase fields and one three-phase field. The limits of solubility of niobium in ZrC have been established and the parameters of the lattices of complex nonstoichiometric carbides and the melting points of the alloys have been established, which made it possible to construct a ZrC–Nb polythermal profile passing in part through the above-mentioned three-phase field. Author

N67-17517*# National Aeronautics and Space Administration, Washington, D. C.
STRUCTURE OF ALLOYS OF THE Zr–C–Ta SYSTEM [STROYENIYE SPLAVOV SISTEMY Zr–C–Ta]
A. I. Avgustinik and S. S. Ordan'yan Dec. 1966 8 p refs Transl. into ENGLISH from Zh. Prikl. Khim. (Moscow), v. 39, no. 2, 1966 p 318–322
(NASA-TT-F-10646) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An isothermal section and a ZrC–Ta polythermal section were constructed at 2273°K on the basis of data from radiographic, metallographic and chemical analyses and determination of the melting points of alloys of the Zr–C–Ta system and it was demonstrated that triple compounds do not exist in the system. In the solid state there are three single-phase fields—$Zr_xTa_yC_z$ (Ta, Zr)$_2$C and (Ta, Zr); three two-phase fields—$Zr_xTa_yC_z$ + (Ta, Zr), (Ta, Zr) + (Ta, Zr)$_2$C and (Ta, Zr)$_2$C + $Zr_xTa_yC_z$; and the three-phase field—$Zr_xTa_yC_z$ + (Ta, Zr)$_2$C + (Ta, Zr), that is, only phases existing in the corresponding double systems. Author

N67-17531# Soudometal, S. A., Brussels (Belgium).
STAINLESS STEEL CLADDING OF HEAVY GAGE STEELS Special Report No. 1
[1965] 12 p Prepared in cooperation with Ghent Univ. (Belgium) and Neratoom, N. V.
(Contract EURATOM-008-63-12 TEEB)
(EURAEC-1685; EUR-2872) CFSTI: HC $3.00/MF $0.65

A study was made of the tape-submerged arc method for cladding steel with stainless steel. The effects of welding parameters on the properties of 1- and 2-layer claddings were studied for various tape sizes and 100-mm-thick steel plate. The measurements included geometrical dilution, chemical analysis of deposits, microhardness, mechanical tests, X-ray diffraction, and electron microanalysis. It is concluded that austeno-martensitic structures must be avoided in the first layer. NSA

N67-17544# Organization for Industrial Research, TNO, The Hague (Netherlands).
A NEW DETERMINATION OF THE EMBRITTLEMENT IN STEEL USING SMALL SPECIMENS (≈ 0.2 cc) IN PARTICULAR WITH RESPECT TO IRRADIATION Progress Report, 1 Apr.–30 Jun. 1966
H. C. van Elst 11 Jul. 1966 42 p refs
(Contract EURATOM-060-64-11 TEEN)
(EURAEC-1691; M-66-596-50005; EUR-2878) CFSTI: HC $3.00/MF $0.65

The embrittlement of (4 pressure vessel) steels by neutron radiation doses at 80°C was measured using the stress wave attenuation test; earlier results were corroborated. The store facilities for the irradiated specimens had to be extended for newly arrived specimens which received the (highest) dose of ca. 4×10^{20} n/cm^2 at 80°C. The dynamic stress–strain diagrams at performance of the stress wave attenuation test for some specimens at high and low temperatures were deduced from the recorded oscillograms. Besides the anticipated influence of temperature and irradiation, a delayed deformation was suggested, i.e., an increase of deformation with decrease of stress. Author (NSA)

N67-17573# IIT Research Inst., Chicago, Ill. Technology Center.
YIELD PHENOMENA AND FRACTURE OF HYDRIDED ZIRCONIUM Quarterly Report, 1 Apr.–30 Jun. 1966
15 Aug. 1966 35 p refs
(Contract AT(11-1)-578)
(IITRI-578-P27-20; IITRI-B6035-20; EURAEC-1707) CFSTI: HC $3.00/MF $0.65

The relationships between yield point and strain-hardening coefficient of high-purity polycrystalline Zr (0.005 to 0.009 mm average grain diameter) with temperature (−200° to +200°C) were investigated. The yield point consistently appeared with increasing temperature, provided that the grain size was favorable. The results accentuated the first-order importance of fine grain size in yield point occurrence. Also, the smaller grain size was accompanied by a lower strain-hardening coefficient. For each grain size, however, the strain-hardening coefficient was statistically constant with varying temperature. The effects of temperature were explained on the basis of the viscous behavior of grain boundaries relative to grain size. By means of dynamic transmission electron microscopy, dislocation behavior was observed in relatively fine-grained (≈0.005 mm) and coarse-grained (≈0.008 mm) materials air-cooled from the final annealing temperature. Considerably less dislocation generation mobility, and interactions were found resulting from strain in the fine-grained material. The results supported the mobile dislocation concept (Johnston–Hahn model) for the yield point phenomenology. The lower strain-hardening coefficient accompanying smaller grain size was a manifestation of these same structural effects. Author (NSA)

N67-17577# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DEFECT STRUCTURES IN NEUTRON IRRADIATED NICKEL
B. Mastel and J. L. Brimhall 11 Jul. 1966 7 p Presented at 24th Ann. Meeting of the Electron Microscope Soc. of Am., San Francisco
(Contract AT(45-1)-1830)
(BNWL-SA-782; CONF-660806-1) CFSTI: HC $3.00/MF $0.65

Results of neutron irradiation of Ni foils at 40°C are discussed. Results indicate that both vacancy and interstitial defect clusters are produced under these conditions. The displacement spike mechanism is offered to explain the short-range mobility and subsequent clustering of vacancies. Annealing causes breakup of the vacancy clusters into free vacancies which annihilate interstitial clusters and cause other vacancy loops to grow. NSA

N67-17579# Nuclear Materials and Equipment Corp., Apollo, Pa.
GROWTH OF SINGLE CRYSTALS OF PLUTONIUM Progress Report, 1 Apr.–30 Jun. 1966
20 Jul. 1966 25 p refs
(Contract AT(30-1)-3428)
(NUMEC-3428-23) CFSTI: HC $3.00/MF $0.65

Large grains of alpha 2.0 mm×2.4 mm were grown by subjecting plutonium with an average grain size of 0.030 mm to a pressure of 25 kilobars at 350°C for 8 hours followed by cooling to room temperature under pressure. A constant-temperature oil bath to be used for growing large grains of alpha by an isothermal transformation technique was designed, constructed, tested, and installed in a glove box. Author (NSA)

N67-17625# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF SELECTED SUBMICRON POWDER BLENDING METHODS FOR DISPERSION ALLOYS
L. Frederick Norris, Gustav Reinhardt, and Walter S. Cremens Washington, NASA, Feb. 1967 29 p refs
(NASA-TN-D-3834) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A cartridge-actuated press was used to compact blended powder specimens to densities adequate for examination with the electron microscope while avoiding agglomeration due to prolonged heating at high temperatures. An automatic film scanner developed specifically for lineal analysis of dispersion microstructures was used to obtain microstructural parameters that were based on much more extensive and intensive examination than had previously been feasible. Blends consisting of 0.054-micron nickel powder with 5.4-volume-percent 0.025-micron aluminum oxide were prepared by wet and dry methods. Wet blending methods proved to be superior to dry methods and yielded interparticle spacings as small as 0.96 micron (mean free path). This result was only twice as large as that predicted for an ideal random mixture of the powders, which indicated a high efficiency of blending for submicron powders that can give interparticle spacings in the range desired for dispersion-strengthened alloys. Author

N67-17663# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
HYDROGEN EMBRITTLEMENT RESULTING FROM CORROSION, CATHODIC PROTECTION, AND ELECTROPLATING Final Report, 14 May 1965–May 1965–13 May 1966
E. Gileadi Sep. 1966 36 p refs
(Contract N156-46659)
(AD-641089) CFSTI: HC $3.00/MF $0.65

A technique was developed and the apparatus built for a fast, nondestructive method for the determination of hydrogen content of large specimen. Also, a study of the basic factors which determine the solubility and the rate of diffusion of hydrogen in metals was undertaken. The approach was to change systematically the metallurgical and physical properties of iron by forming binary alloys of variable composition, and to study the resulting changes in hydrogen diffusion rate and solubility. TAB

N67-17685# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
CORROSION OF CARBON AND ALLOY STEELS IN WATER AND SEAWATER
S. A. Reed Oct. 1966 20 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1612) CFSTI: HC $3.00/MF $0.65

Current knowledge of the factors that govern the corrosion and the service life of steel in sea water evaporation environments is summarized. Some data from OSW research and development reports are included. It is concluded that information currently available is inadequate to provide any reliable estimate of the life expectancy of carbon steel in sea water evaporator environments. Additional testing is necessary at lower dissolved oxygen levels to determine more precisely the role of oxygen in the corrosion of steel in hot sea water and brine. (25 references). NSA

N67-17696# California Univ., Berkeley. Lawrence Radiation Lab.
DYNAMIC STRAIN AGING OF A HIGH STRENGTH STEEL
V. Goel, R. Busch, and V. F. Zackay Mar. 1966 32 p refs Presented at the Am. Soc. of Metallurgists Meeting, Cleveland, 12 Nov. 1966
(Contract W-7405-ENG-48)
(UCRL-16761; CONF-661101-1) CFSTI: HC $3.00/MF $0.65

The response of quenched and tempered and ausform H-11 steel to strain aging was investigated. The straining temperature

was the most important variable. Straining at temperatures up to 900°F and retempering resulted in large increases (≈30%) in yield strength without the loss in ductility associated with static strain aging. The yield-to-ultimate-strength ratio approached unity in the strain-aged steels, however, elongations of 8–12% were retained. Author (NSA)

N67-17699# California Univ., Berkeley. Lawrence Radiation Lab.
STRENGTHENING MECHANISMS OF ULTRA-HIGH-STRENGTH AUSTENITIC STEELS
Dieter Fahr (M.S. Thesis) Jun. 1966 51 p refs
(Contract W-7405-ENG-48)
(UCRL-16922) CFSTI: HC $3.00/MF $0.65

The development of a high-strength stable austenitic steel was investigated. A composition expected to show stabilization and dispersion strengthening as results of thermomechanical processing was selected. The principal variables investigated were the amount and temperature of deformation and the temperature of aging after deformation. The mechanical properties were most sensitive to the amount of deformation. Both strength and ductility increased with prior deformation. Within the ranges studied, the deformation and aging temperatures had a smaller effect on the properties. The stabilization of the austenite also depended on the amount of reduction. With large deformations, the M_s temperature was lowered from −50°C (undeformed) to about −196°C. Optimum thermomechanical processing produced a stable austenitic steel with the following mechanical properties: 180,000 psi yield strength, 270,000 psi ultimate tensile strength, 20% elongation, and 40% reduction in area. Author (NSA)

N67-17700# Japan Atomic Energy Research Inst., Tokyo.
SWELLING OF METALLIC URANIUM
Rukichi Nagasaki and Satoru Kawasaki Jul. 1966 14 p refs
In JAPANESE; ENGLISH summary
(JAERI-4037)

The swelling of U metal is caused mainly by coalescence of fission gas bubbles, and sometimes by crack formation. When the gas bubble is small, the pressure of the bubble depends on the surface tension of the matrix. Swelling can be suppressed by dispersing bubbles formed to prevent coalescence. One proposed mechanism of bubble growth is that bubbles migrate by surface diffusion of the matrix atoms and coalesce with one another, and the other than inert gas atoms in small bubbles dissolve into the matrix and precipitate out in larger bubbles. It appears that at high temperatures near the melting point, these two mechanisms are both operative, and at temperatures below this only the former operates. The largest contribution to the swelling of U is the migration of grain boundaries. Various experiments which are involved in the swelling other than by irradiation of U, and the conditions for crack formation in irradiated U metals are also discussed. Author (NSA)

N67-17711# Naval Research Lab., Washington, D. C.
METALLURGICAL CHARACTERISTICS OF HIGH STRENGTH STRUCTURAL MATERIALS Quarterly Report
R. J. Goode, R. W. Huber, R. W. Judy, Jr., D. G. Howe, and P. P. Puzak et al Apr. 1966 112 p refs
(NRL-6454; QR-10; AD-641262) CFSTI: HC $3.00/MF $0.65

A progress report covering the research studies in high strength structural metals conducted in the period December 1965 through March 1966 is presented. The report includes fracture toughness studies on expected normal production 12%-Ni maraging and 9Ni-4Co-0.25C steels, a variety of circular rolled and conventionally rolled titanium alloys, and aluminum alloys using a standard engineering developed, and linear elastic fracture mechanics type fracture toughness tests. Preliminary correlations of Kic with drop weight tear test energy for a variety of titanium alloys are presented. Low cycle fatigue crack propagation in 12%-Ni maraging steels in air and salt water is described and compared to the behavior of other steels. Also, crack initiation versus propagation failure criteria for low cycle fatigue in air and in aqueous environments is presented for HY-80 and 5Ni-Cr-Mo-V steels and 12%-Ni maraging steels. The stress-corrosion-cracking resistance of a variety of titanium alloys and several aluminum alloys has been determined using a cantilever-bend test; comparison of results obtained in the laboratory and in natural seawater at Key West are presented for a Ti-7Al-2Cb-1Ta alloy. Author (TAB)

N67-17719# Utah Univ., Salt Lake City. Dept. of Metallurgy
THE RECRYSTALLIZATION KINETICS AND ELECTRON MICROSCOPY OF MAGNESIUM AND CHROMIUM Final Scientific Report, Oct. 1964–Oct. 1966
Charles H. Pitt, Charles R. Brinkman, Ernest L. Moore, Theron G. Odekirk, and William J. Hong Oct. 1966 156 p refs
(Grant AF-AFOSR-39-65)
(TR-2; AFOSR-66-2838; AD-643764) CFSTI: HC $3.00/MF $0.65

The effect if grain size and degree of deformation on the recrystallization temperature of pure magnesium was determined. The effects of the alloying elements Mn, Fe, Co, Ni, Zn and Cd in amounts ranging from .005 to .02 atomic per cent recrystallization temperature and kinetics were determined. It was found that the effect on recrystallization temperature of solute additions was not a function of their atomic size or electronic structure but seemed to be related to the distribution coefficient of the solute. The recrystallization kinetics were determined for pure chromium and electron microscopic studies made of dislocation structures during various stages of recovery and recrystallization. The activation energy for recrystallization was found to be the same as the activation energy for self-diffusion in chromium. Finally grain growth measurements have been made for pure magnesium which indicates that secondary recrystallization invariably follows primary recrystallization. The activation energy for grain growth was found to be about one-half the activation energy for magnesium self-diffusion which indicates that the growth process is controlled by atomic migration across the boundary. Equations are given which fit the kinetic process observed in recrystallization and grain growth. TAB

N67-17728# California Univ., Livermore. Lawrence Radiation Lab.
EFFECT OF STRESS STATE ON FLOW AND FRACTURE OF SEVERAL HIGH-STRENGTH ALLOYS
Maurice Zaslawsky 27 Apr. 1966 38 p refs Prepared Jointly with Space Technol. Labs., Redondo Beach, Calif.
(Contract W-7405-ENG-48)
(UCRL-14863) CFSTI: HC $3.00/MF $0.65

Stress–strain data were obtained under uniaxial and equal biaxial stresses on ten high strength materials: seven tool steels, two maraging steels, and a beta titanium. From the results it is shown that the strength of a material under biaxial stress cannot be predicted on the basis of its strength under uniaxial stress. Author

N67-17738# Argonne National Lab., Ill.
IMPROVEMENTS IN CONSOLIDATION AND FABRICATION OF VANADIUM-20 w/o TITANIUM (TV-20)
W. R. Burt, Jr., W. C. Kramer, F. J. Karasek, and R. M. Mayfield May 1966 33 p refs
(Contract W-31-109-ENG-38)
(ANL-7127) CFSTI: HC $3.00/MF $0.65

Improvements in consolidation and fabrication techniques for V–20 wt % Ti are presented. Major emphasis is placed on tubing fabrication with significant progress having been made in tube-blank extrusion, tube reducing, and drawing. A newly designed and built three-roll tube-reducing machine shows much promise. Use of a plastic base coat in conjunction with the drawing lubricant allowed carbide draw dies to replace aluminum–bronze dies, with subsequent improvement in dimensional control. Commercial efforts in drawing V–20 wt % Ti tube-blanks furnished by ANL were highly successful. Author (NSA)

N67-17751# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WEAR RESISTANCE OF ALLOYS FOR GAS TURBINE INSTALLATIONS
A. I. Lavysh and M. G. Morozov 7 Oct. 1966 11p refs Transl. into ENGLISH from Izv. Vysshikh Uchevn. Zavedenii, Energ. (Minsk), no. 9, 1965 p 115–119
(FTD-HT-66-511; TT-67-60233; AD-643876) CFSTI: HC $3.00/MF $0.65

The problem of structural materials for gas turbine installations has been satisfactorily solved by the level of their heat resistance and it was perfectly and entirely uncovered with respect to wear resistance. TAB

N67-17832*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEXTURE STRENGTHENING AND FRACTURE TOUGHNESS OF 4Al–0.2O AND 5Al–2.5Sn ELI TITANIUM SHEET BIAXIAL STRESS FIELDS AT ROOM AND CRYOGENIC TEMPERATURES
Timothy L. Sullivan Washington, NASA, 1967 26 p refs Presented at the Natl. Tech. Meeting on Appl. Related Phenomena in Titanium Alloys, Los Angeles, 17–18 Apr. 1967; Sponsored by Am. Soc. for Testing and Mater.
(NASA-TM-X-52272) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Burst tests of six-inch diameter cylindrical pressure vessels (1 to 2 stress field) fabricated from nominally 0.020 inch thick material showed significant increases in strength over uniaxial values. Biaxial yield strengths as high as 1.53 times uniaxial yield were obtained. The Ti–4Al–0.2 O alloy with a room temperature plastic Poisson's ratio of 0.845 (R = 5.45) generally had greater biaxial yield, ultimate, and weld strength at a given temperature than did the Ti–5Al–2.5Sn ELI alloy (room temperature plastic Poisson's ratio equals 0.732; R = 2.73). However, tests of cracked cylinders at −320 and −423°F showed the Ti–5Al–2.5Sn ELI alloy had less notch sensitivity for through-the-thickness cracks 0.1 inch or longer. Plastic Poisson's ratio obtained from a uniaxial tension test was used to predict the amount of biaxial strengthening. Author

N67-17881# Sandia Corp., Albuquerque, N. Mex.
THE EFFECT OF HYDROSTATIC PRESSURE (14 kbar) ON THE ULTIMATE COMPRESSIVE STRENGTH OF VARIOUS SINTERED MATERIALS
Thomas L. Cordell and James A. Corll Aug. 1966 18 p refs Presented at the Am. Soc. of Mech. Eng. Ann. Winter Meeting, New York, 27 Nov.–2 Dec. 1966
(Contract AT(29-1)-789)
(SC-DC-66-1888; CONF-661102-4) CFSTI: HC $3.00/MF $0.65

The investigation of the increase in ultimate compressive strength of sintered materials as a function of hydrostatic support pressures up to 14 kbar is reported. Six WC materials and five oxide ceramics were tested. All materials displayed significant increase in axial ultimate compressive strength when radially loaded by fluid pressure. For example: the ultimate compressive strength of WC with 3% Co binder is raised from 52 kbar to 92 kbar by 14 kbar fluid support pressure. A schematic design employing this effect in the design of a high pressure apparatus is included. Author (NSA)

N67-17883# MSA Research Corp., Evans City, Pa.
DESIGN PROPERTIES OF ONE HEAT OF 2 1/4 Cr-1 Mo STEEL AND 316 STAINLESS STEEL IN HIGH TEMPERATURE AIR, HELIUM, AND SODIUM ENVIRONMENTS
R. C. Andrews and L. H. Kirschler 14 Sep. 1966 78 p refs
(Contract AT(11-1)-765)
(MSAR-66-174; Rept.-7) CFSTI: HC $3.00/MF $0.65

Results are presented from tests of the mechanical properties of steels exposed to air, He, high-oxygen Na, low oxygen Na, and Na with a continuous C source at 1100°F. In the case of 2-1/4 Cr–1 Mo steel, both the thermal aging during the He tests and the decarburization during the Na tests appeared to weaken the material after prolonged exposures. The contamination of the Na with O_2 appeared to accelerate this weakening by increasing the rate of decarburization. The most critical effects, upon exposure to 1100°F Na, were noted in the decrease of both rupture strength and creep strength. Results with 316 stainless-steel indicated that thermal aging weakened the material slightly after prolonged exposures. The extreme levels of carburization obtained during the high-C creep-rupture tests embrittled the material to a point where there was almost a complete loss of ductility. Concurrent with this loss of ductility, there was an increase in both rupture and creep strength. NSA

N67-17890# Chantiers de l'Atlantique Saint-Nazaire (France).
DETERMINATION OF THE TRANSFORMATION CURVES FOR CONTINUOUS COOLING OF Mn–Mo STEEL FROM 1100°C, 1 APRIL–30 JUN. 1966
25 Apr. 1966 12 p refs *Its* Spec. Rept.-14, Study no. 965
(Contract EURATOM-054-61-12 RDF)
(EURAEC-1677; EUR-2867) CFSTI: HC $3.00/MF $0.65

The transformation curves for continuous cooling of Mn–Mo–V steel were determined under Ar. The specimens were austenitized at 1100°C for 30 min. Various types of cooling, from quenching in water to cooling at a controlled rate of 50°C/hr, were applied. Results of micrographic examinations of structure are shown. The transformation diagrams are compared with transformation diagrams plotted after austenitization at 920°C; no significant difference is found. NSA

N67-17940# Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Materials Lab.
EFFECT OF IRRADIATION ON THE HIGH-STRAIN FATIGUE BEHAVIOUR OF A LOW-CARBON HIGH-MANGANESE AND A LOW-ALLOY STEEL
D. S. Wood and E. R. Johnson 1966 15 p refs
(TRG-1277(C)) CFSTI: HC $3.00/MF $0.65

High-strain bending fatigue tests have been carried out at ambient temperature on a low-C high-Mn steel and a low-alloy steel after irradiation at ≈140°C to doses of ≈ 1×10^{20} n/cm² (> 1 MeV). The results indicate that irradiation has a small effect on the high-strain fatigue behaviour. At total strain ranges above about 3%, irradiation reduces the number of cycles to failure, but below this strain level the number of cycles to failure is increased. Since engineering structures are likely to operate at total strain ranges below 1% it is concluded that in practice irradiation should not reduce the number of cycles to failure and may even be beneficial. Author

N67-17985*# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
INVESTIGATION OF THE SOLIDIFICATION, STRUCTURE AND PROPERTIES OF EUTECTIC ALLOYS INCLUDING CONSIDERATION OF PROPERTIES CONTROL Semiannual Progress Report
R. W. Hertzberg, R. N. Tauber, and R. W. Kraft 15 Jan. 1967 14 p
(Grant NGR-39-007-007)
(NASA-CR-81669; SAPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Research on highly anisotropic binary eutectic alloys produced by unidirectional solidification under closely controlled conditions is reported. The behavior of an Al–Al_2Ni eutectic system was investigated to determine the effect of cyclical stresses upon the integrity of the fiber-matrix interface. Preliminary findings in this study suggest that the cyclic action of fatigue loading causes damage at or near the fiber-matrix interface. The progress of investigations on the stress rupture properties of a controlled Ni–Ni_3Nb eutectic, the thermal stability of the Al–Al_2Ni eutectic, and the galvano-thermo-magnetic effects in a controlled Bi–Zn eutectic is also discussed. A.G.O.

N67-18010*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
CREEP AT ELEVATED TEMPERATURES AND HIGH VACUUM Semiannual Report No. 5
K. Schroeder, A. Giannuzzi, and G. Gorsha Dec. 1966 13 p refs
(NASA-CR-81721; SURI-MET-E-1266-SA) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Creep tests in high vacuum and elevated temperatures were continued on copper of 99.9% purity and silver of 99.999% purity. The experimental results indicated that the minimum creep rate decreased if an initially argon bombarded and tested sample was annealed in air and retested in the same vacuum and temperature. The results are surprising since a silver sample should interact at elevated temperatures with air quite differently than copper because silver oxide is not stable in our testing conditions, whereas copper samples showed quite strong oxide films. It is therefore more likely, that the reduction of the creep rate is not due to an oxide film. It is more likely associated with the absorption of oxygen in the sample, where it may either harden grain boundaries, retard the operation of dislocation sources, or increase frictional forces on moving dislocations. It is also possible that a partial oxygen monolayer could interfere with slip line formation. Author

N67-18080 Joint Publications Research Service, Washington, D. C.
REFRACTORY COMPOUNDS AND THEIR ROLE IN ENGINEERING
A. E. Nikorov 11 Jan. 1967 80 p refs Transl. into ENGLISH of the Publ. Zharoprochnyye Soyedinenya i Ikh Rol' v Novoy Tekhnike" Moscow, Znaniye, 1966 p 3–62
(JPRS-39488; TT-67-30138)

A review is presented of the properties of different classes of refractory compounds and their use in engineering. Refractory materials are first considered by their properties. Other discussions include: scaling-resistant oxides, carbides and nitrides, and cermets. Next, methods of synthesizing scaling-resistant and refractory compounds are described. Means of temperature measurement with thermocouples, resistance thermometers, and noise thermometers are reviewed. Various types of furnaces for generation of high temperatures such as resistance and induction furnaces, electric arc furnaces, electron beam melting, solar furnaces, and electric arc reflector furnaces are considered. Finally the application of refractory and scaling-resistant substances to the fields of aerospace and nuclear technology are cited. S.P.

N67-18147*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CRACK PROPAGATION, DELAYED FAILURE, AND RESIDUAL STATIC STRENGTH OF TITANIUM, ALUMINUM, AND STAINLESS STEEL ALLOYS IN AQUEOUS ENVIRONMENTS
I. E. Figge and C. Michael Hudson Washington, NASA, Feb. 1967 44 p refs
(NASA-TN-D-3825) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An investigation of crack propagation, delayed failure, and residual static strength was conducted on titanium, aluminum, and stainless steel alloys in air, in a 3-1/2 percent salt solution, and in sea water. Fatigue cracks grew approximately 2 to 3 times faster in the aqueous environment than in air in Ti–8Al–1Mo–1V (duplex annealed) titanium alloy and 7075-T6 aluminum alloy. In the 2024-T3 aluminum alloy, the aqueous environment had a deleterious effect on the crack growth rate at the lower stress levels and a beneficial effect at the high stress levels. In general, the delayed failure strengths of the aluminum and stainless steel alloys were essentially the same as their residual static strengths in air. The delayed failure strengths of the titanium alloys were lower than their residual static strengths by various degrees depending on the material and thickness. The residual static strength of the aluminum alloys was not affected by the aqueous environment. Author

N67-18154*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
STRESS-CORROSION CRACKING OF Ti–6Al–4V ALLOY IN METHANOL
Robert L. Johnston, Robert E. Johnson, Glenn M. Ecord, and Willard L. Castner Washington, NASA, Feb. 1967 20 p
(NASA-TN-D-3868) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Results of an investigation to determine if an incompatibility exists between methanol and Ti–6Al–4V solution-treated and aged alloy are presented. The test specimens were obtained from virgin solution-treated-and-aged sheet material and from the remnants of two Apollo service propulsion system fuel tanks which failed while containing methanol under pressure. The investigation shows that methanol and stressed Ti–6Al–4V alloy are incompatible and result in tank failure because of a stress-corrosion mechanism. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-16823# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
SPECTROSCOPIC PROPERTIES OF COATINGS Initial Report
John R. Wilt Oct. 1966 11 p refs
(CCL-212; AD-642711) CFSTI: HC $3.00/MF $0.65

A program to obtain and use reflectance spectra of organic coatings is described. Reflectance spectra will be obtained in the 0.2-40 micron spectral region and stored in a format suitable for use on an automatic digital computer. Author (TAB)

N67-17301# Georgia Univ., Athens. Dept. of Physics and Astronomy.
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Annual Progress Report
William C. Sears 12 Sep. 1966 22 p refs
(Contract AT(40-1)-2418)
(ORO-2418-1) CFSTI: HC $1.00/MF $0.50

Molar absorptivities and integrated absorption intensities for trans-vinylene, vinyl, vinylidene, and cis-trisubstituted ethylene groups were evaluated from polymers and olefin solutions in carbon tetrachloride exposed in the LITR. Trans-vinylene group concentrations in polyacrylonitrile, acrylonitrile–butadiene 45/55 copolymer, and an acrylonitrile–styrene 29/71 copolymer were calculated on the basis of molar absorptivities and integrated absorption intensities determined on noncrystalline standards. It was determined that the G values for trans-vinylene group formation in polyacrylonitrile, a 29/71% acrylonitrile–styrene copolymer, and a 45/55% acrylonitrile–butadiene copolymer were ±0.15, −5.1, and 0.012, respectively. It was concluded that the styrene component confers a protective effect toward the acrylonitrile component in trans-vinylene growth. Likewise, it was concluded that the acrylonitrile component confers a protective effect toward destruction of trans-vinylene groups in the butadiene component. NSA

N67-17450# Eagle-Picher Co., Miami, Okla.
PURIFICATION AND CRYSTALLIZATION OF AMORPHOUS BORON POWDER; RECOVERY AND PURIFICATION OF BORON FROM RESIDUES AND SCRAP Technical Report, 1 Jul. 1965–30 Jun. 1966
John R. Musgrave, Ralph J. Starks, Harold E. Erwin, John T. Buford, and George E. Biggerstaff 30 Jun. 1966 29 p
(Contract AT(40-1)-3327)
(TID-23342) CFSTI: HC $3.00/MF $0.65

Methods for purifying and crystallizing amorphous boron-10 in quantities sufficient for evaluation were developed. Sintering of isostatic compacts gives good crystallinity and improved purity, although it does not remove the bulk of metallic impurities. Horizontal zone refining gives good crystallinity, high purity, and a marked reduction in metallic impurities. Processing of scrap material is described which results in a crystalline, high purity material with only a small amount of metallic impurities. Author (NSA)

N67-17502*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OXIDE-CATHODE DURABILITY IN MERCURY ELECTRON-BOMBARDMENT ION THRUSTOR
William R. Kerslake Washington, NASA, Feb. 1967 28 p refs
(NASA-TN-D-3818) CFSTI: HC $3.00/MF $0.65 CSCL 21C

The results of lifetime testing of oxide cathodes in mercury discharge chambers at emissions of 0.3 to 0.5 ampere per square centimeter are presented. High cathode erosion rates, probably due to ion sputtering, necessitated the construction of heavy layers of wire-reinforced oxide to provide lifetimes up to 5000 hours. An oxide-coated brush cathode gave the best lifetime of any cathode operated in an actual thrustor. Operation at low discharge voltages greatly extended the lifetime of cathodes. Calculated and measured losses of the oxide coating are compared. If additional cathode improvements can be made, the program goal of 10,000 hours may be reached. The brush cathode also survived shaking, thermal shock, and heat cycling that would be required for a space mission. Miscellaneous cathode types were also tested, but proved to be less durable than the thick oxide type. Author

N67-17547# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
ANALYTICAL DESCRIPTION OF GROWTH OF BERYLLIUM OXIDE DURING NEUTRON IRRADIATION
A. W. Pryor and B. S. Hickman Apr. 1966 10 p refs
(AAEC-TM-318)

An analytical model is developed which describes the available data on the lattice and macroscopic growth of BeO under neutron irradiation. The model is used for interpolation and extrapolation of existing data. The model has a large number of adjustable parameters and it is emphasized that it does not necessarily bear any direct relation to the actual defect structure. Author (NSA)

N67-17660# Avco Corp., Wilmington, Mass. Space Systems Div.
SYNTHESIS OF NEW SOLID-STATE MATERIALS BY ULTRAHIGH PRESSURE TECHNIQUES Final Report, 14 May 1963–14 Oct. 1966
A. J. de Lai, R. M. Haag, and T. Vasilos 20 Dec. 1966 104 p refs
(Contract AF 19(628)-2943)
(AFCRL-66-737; AVSSD-0314-66-RR; AD-643861) CFSTI: HC $3.00/MF $0.65

The microstructure and physical properties of dense oxides prepared at ultrahigh pressure and low temperature were studied. Completely dense, transparent magnesium oxide was prepared in submicron grain sizes with hardness values twice that of single crystal material and 30 percent to 50 percent greater than that of hot pressed material. A new modification of samarium oxyhydroxide was found and characterized. X-ray determinations on the compressibility of alkali halides, RbCl, RbBr, are reported. Author (TAB)

N67-17670# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROTECTION OF METALS WITH RUBBER COATINGS AGAINST CAVITATIONAL WEAR
V. M. Konovalov and K. Shebalin 7 Oct. 1966 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 9, 1965 p. 86–89
(FTD-HT-66-510; AD-643734) CFSTI: HC $3.00/MF $0.65

The protective ability of rubber coatings against cavitational wear was investigated by two methods: movable and stationary sample. The tests showed that soft rubber coatings provide the best protection. Soft rubber coatings are especially effective in the protection of details, the natural movement and vibration of which in a liquid cause their cavitational wear. TAB

N67-17715# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORETICAL ANALYSIS OF UNSTEADY HEATING AND DESTRUCTION OF A GLASS–PLASTIC IN THE REGION OF THE STAGNATION POINT
Yu. V. Polezhayev 2 Sep. 1966 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1964 p 3–8
(FTD-HT-66-279; AD-643733) CFSTI: HC $3.00/MF $0.65

A schematic model of unsteady destruction of a complex glass-like material consisting of glass fiber (filler) and an organic binder is proposed. The process of thermal expansion of the binder is calculated taking into account the kinetics of the chemical reaction. The interaction of the processes of fusion and coking is analyzed and the effect of separate thermophysical parameters on the surface temperature and the rate of mass removal from the heat-insulating material is shown. A typical glass-plastic is composed of glass fiber cemented together by an organic resin. The process of unsteady destruction of such a material in a high-temperature flow of gas includes: in a certain temperature

range the formation of a zone of thermal expansion (coking) of the organic binder, filtration of the gaseous products of coking through the porous remainder, and gradual softening of this remainder with the formation of a liquid film of melt. Author (TAB)

N67-17922# Royal Aircraft Establishment, Farnborough (England).
CONCERNING THE TRACING OF CAPILLARIES IN GLASS-FIBRE REINFORCED POLYESTER RESINS BY RADIOCHEMICAL AND ELECTRICAL METHODS [UEBER DEN NACHWEIS VON KAPILLAREN IN GLASFASERVERSTARKTEN POLYESTERHARZEN MIT HILFE RADIOCHEMISCHER UND ELEKTRISCHER METHODEN]
J. Gaehde and G. Pohl Oct. 1966 14 p refs Transl. into ENGLISH from Plaste Kautschuk (Leipzig), v. 13, no. 4, 1966 p 207–209
(RAE-LIB-TRANS-1180) CFSTI: HC $3.00/MF $0.65

An important role is played by pores and capillaries where the water absorption of glass-fibre reinforced plastics is concerned. The size and range of these has not, up to the present time, been fully clarified. A continuous capillary system could be traced both by radiochemical means and by measurement of the ohmic resistance—the two methods being independent of each other. By means of autoradiographic photographs, an aggregation of capillaries along the glass fibres could be seen. From resistance measurements it was shown that the individual capillaries are not connected with each other. The radius of the capillaries was estimated from measurements obtained, to be about 0.35×10^{-4} cm. It was also established that the number of capillaries roughly corresponded to the number of elementary fibres. Author

N67-17943# Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Chemie.
RADIATION AGED WOOD–PLASTIC COMBINATIONS [STRAHLUNGSAUSGEHAERTETE HOLZ-KUNSTSTOFF-KOMBINATIOEN]
F. Guetlbauer, E. Proksch, H. Bildstein, and E. Slais [1966] *In* GERMAN Submitted for Publication
(SGAE-CH-39/1966) CFSTI: HC $3.00/MF $0.65

Irradiation of wood, previously impregnated with plastics, produced well aged wood–plastic materials of appealing exterior and high strength properties. Details presented cover fabrication methods, plastic-wood properties, production costs, and application aspects. Transl. by G.G.

N67-17945# Rubber Research Inst. TNO, Delft (Netherlands).
RUBBER RESEARCH INSTITUTE
H. Galdof 11 Oct. 1966 6 p In DUTCH
(TDCK-46587) CFSTI: HC $3.00/MF $0.65

Samples from neoprene and PVC ship cable sleeves were tested to evaluate their behavior when exposed to diesel oil. The test arrangement consisted of an open-ended cylinder that was placed upright on the flat samples and then filled with diesel oil. Hardness, oil absorption, changes in weight, and loss of softeners in the samples were measured at regular intervals during a 100-day period. Results were presented in graphs and in a table. Transl. by K.W.

N67-17975*# Monsanto Research Corp., Everett, Mass. Boston Lab.
SEPARATOR DEVELOPMENT FOR A HEAT STERILIZABLE BATTERY Quarterly Summary Progress Report No. 2, 1 Sep.–30 Nov. 1966
John J. O'Connell and Elizabeth A. McElhill 30 Nov. 1966 27 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951524)
(NASA-CR-81610; MRB623402) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Three types of ligand-containing polymers that showed high stability to 40% KOH in screening tests were comprehensively evaluated as battery separator materials. They are: (1) 2-vinylpyridine–methylmethacrylate copolymers, (2) styrenemaleic anhydride copolymers, and (3) polystyrenes containing ligand substituents. These polymers, either as unsupported films or as heterogenous membranes on polypropylene substrates, are being evaluated before and after a 60-hour exposure to 40% KOH saturated with silver oxides at 135°C. The properties measured in the study include dimensional stability, electrical resistance, electrolyte adsorption, tensile strength, pore size, and resistance to penetration by zinc dendrites. Membranes prepared from both 2-vinylpyridine–methacrylic acid and styrene–maleic anhydride have shown electrical resistances under 20 ohm-in. and survived the above exposure cycle satisfactorily. Polystyrenes with ligand substituents such as 8-hydroxyquinoline, 2-pyridylmethylamine, and iminodiacetic acid have also been prepared. Author

N67-17994* University of Southern Calif., Los Angeles.
RESEARCH AND DEVELOPMENT STUDY ON THE RELATIONS BETWEEN VISCOSIMETRIC AND THERMODYNAMIC PROPERTIES OF MODERATELY CONCENTRATED POLYMER SOLUTIONS Final Report
R. Simha, Naomi Eliezer, and L. Utracki 27 Dec. 1966 99 p refs
(Contract JPL-951408)
(NASA-CR-81606) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Studies were conducted on the viscosity behavior of moderately concentrated solutions of vinyl aromatic polymers and to extend a proposed new method of generalizing polymer viscosity data into the range of higher concentration. The polymer PAcN was found to be sensitive to light and temperature, and unsuitable for viscosity measurements at higher concentrations. The observations and conclusions concerning this problem are included in a paper entitled: On the Instability of Polyacenaphthalene in Solution. After verifying the stability of the other polyvinyl aromatic samples, the viscosity of their benzene solutions was measured at 30°C. The results are summarized in a paper entitled: Viscosity of Vinyl Aromatic Polymers. The analysis of higher concentrations of 12 different polymer–solvent systems is discussed in a paper entitled: Corresponding State Relations for the Newtonian Viscosity of Polymer Solutions, Part II: Further Systems and Concentrated Solutions. The proposed method is shown to give good results for the concentration range up to 50% of polymer. Literature data for the Huggins parameter for 48 systems were studied in a paper entitled: Molecular Weight Dependence of the Huggins Constant k_1 and the Parameter γ. R.N.A.

N67-18000* IIT Research Inst., Chicago, Ill. Technology Center.
DEVELOPMENT OF A FLEXIBLE MATERIAL RESISTANT TO NITROGEN TETROXIDE AND HYDRAZINE Interim Technical Report, May 16–Nov. 30, 1966
T. H. Metzer and T. Yamauchi 22 Dec. 1966 105 p refs
(Contracts NAS7-100; JPL-951483)
(NASA-CR-81645; IITRI-U6046-6) CFSTI: HC $3.00/MF $0.65 CSLC 11I

Progress is reported on a research project to synthesize novel fluorinated polymer systems to be used in preparing elastomeric bladders suitable for the containment of nitrogen tetroxide and hydrazine fuels. Efforts during this period were directed toward the preparation of polyperfluoroglutaric anhydride, octafluorofuran, perfluoro aromatic systems, and tetrafluorodithietane. R.N.A.

N67-18008* Boeing Co., Seattle, Wash. Space Div.
ANALYTICAL STUDY OF NONMETALLIC PARTS FOR LAUNCH VEHICLES AND SPACECRAFT STRUCTURES Quarterly Progress Report No. 2, Oct. 1, 1966–Jan. 1, 1967

C. F. Tiffany and D. H. Bartlett 1 Jan. 1967 41 p ref
(Contract NAS8-18037)
(NASA-CR-81717) CFSTI: HC $3.00/MF $0.65 CSCL 11D

Continuing research being conducted to determine the applicability of fiber reinforced plastics in spacecraft and launch vehicle structural components, especially for the support of cryogenic tanks, is reported. The development of detailed designs of flat and round tension rods and a compression strut is discussed, and initial results from the beam optimization computer program are briefly considered. Aluminum beams were analyzed for comparison with the nonmetallic parts; comparisons of the two types of beam show the span and loading range where fiberglass construction offers weight savings over aluminum construction. Details are given on the designs, fabrication approach, and test plans. L.E.W.

N67-18009*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF THE KINETICS OF CRYSTALLIZATION OF MOLTEN BINARY AND TERNARY OXIDE SYSTEMS Quarterly Status Report No. 5, Sep. 1–Nov. 30, 1966
James F. Bacon 1 Jan. 1967 12 p refs
(Contract NASw-1301)
(NASA-CR-81720; F910373-5) CFSTI: HC $3.00/MF $0.65 CSCL 11B

A small micro-furnace for direct use under a microscope was constructed and used to study nucleation and crystal growth rates. An enlarged platform furnace useable in air at temperatures up to 1800°C was built for fiberizability research. Equipment was constructed for the dynamic evaluation of the bulk modulus of experimental glasses. Previously established research procedures for the preparation of new experimental glasses, the measurement of the viscosity of these glasses, and the determination of their Young's modulus were continued. An experimental glass was devised which had excellent fiberizing characteristics and whose hand-drawn fiber samples gave values for Young's modulus on eleven occasions ranging from 20 to 27 million psi with variation in heat treatment. However, a limited number of subsequent experiments with this glass gave only lower values of Young's modulus. The methods of testing employed were critically analyzed and all known errors would give too low a value for Young's modulus instead of too high with the single exception of pronounced ellipticity in the fiber, and the original test fibers were destroyed before examination for ellipticity. Author

N67-18093* Army Natick Labs., Mass. Advanced Projects Branch.
STUDIES ON THE STRUCTURE OF RUBBERY POLYURETHANES Status Report, 17 Oct. 1966–17 Jan. 1967
Nathaniel S. Schneider and Stuart B. Clough 17 Jan. 1967 28 p refs
(NASA Order R-135)
(NASA-CR-81749; SR-8) CFSTI: $3.00 CSCL 11J

Mechanical test methods; volume-temperature (calorimetric) measurements including differential thermal analysis and thermogravimetric analysis techniques; and penetrometric (thermomechanical) measurements were used to determine transition temperatures of various rubbery polyurethane compositions. Four distinct transition regions common to the different polyurethane samples were identified in the combined results from a rapid scanning calorimeter and thermomechanical analyzer. The transition below 0°C is the common glass transition. A transition in the region 60–90°C is tentatively identified with the dissociation of a secondary bonded network formed by interactions between the aromatic urethane segments. The transition at about 150°C is ascribed to allophonate bond dissociation. A final transition at 200–220°C could arise from urethane bond dissociation, but in at least one type of polyurethane is due to the melting of birefringent regions present in small concentration. Other results of the study for developing polyurethane films that offer sufficiently high water vapor permeabilities to provide passive thermal control of a space suit by means of pervaporative cooling, are also described. L.S.

N67-18125*# Pennsylvania State Univ., University Park.
THERMAL CONDUCTIVITY STUDIES OF HIGH POLYMERS Final Report
D. E. Kline [1966] 4 p refs
(Grant NsG-611)
(NASA-CR-81782) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Analyses continued on thermal conductivity of various polymer systems, some of which were altered by nuclear radiation for purposes of radiation effects studies. Emphasis was directed toward documenting the series of polymer thermal analysis report. R. U.

N67-18143*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DECOMPOSITION CHARACTERISTICS OF A CHAR-FORMING PHENOLIC POLYMER USED FOR ABLATIVE COMPOSITES
George F. Sykes, Jr. Washington, NASA, Feb. 1967 24 p refs
(NASA-TN-D-3810) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Analysis of the decomposition characteristics of a phenol-formaldehyde polymer by differential thermal analysis, gas chromatography, and elemental analysis has shown the overall process to consist of a series of complex reactions ranging from low-temperature cross linking (curing) to a high-temperature reaction which results in a carbon char. The energy absorption through decomposition was found to be 293 kJ/kg over the temperature range between 350° and 850°C. The efflux of volatile products corresponding to this decomposition consisted of components ranging in molecular weight from hydrogen to dimethylphenol. Fifty percent of the total moles identified were hydrogen and 23.4 percent and 10 percent were found to be water and methane, respectively. Analysis of the residue showed that the carbon char appeared over the 400° to 850°C temperature range concurrent with the formation of volatile oxidized products. The char at 850°C was found to be 92.6 percent carbon, 0.9 percent hydrogen, and 6.5 percent oxygen. Author

N67-18188* Army Natick Labs., Mass.
SORPTION AND DIFFUSION OF WATER IN A RUBBERY POLYURETHANE Status Report No. 7, Apr. 17–Oct. 17, 1966
Nathaniel S. Schneider, Louise V. Dusablon, Harold B. Hopfenberg, Leo A. Spano, and Ferdinand Votta, Jr. 9 Dec. 1966 12 p refs Submitted for Publication
(Contract NASr-135)
(NASA-CR-81801) CFSTI: HC $3.00 CSCL 11J

Results are presented which serve to clarify the nature of the water transport process in a polyester polyurethane and lend additional support and definition to several features of the water sorption and diffusion in relatively unswollen polymers. Unsteady state sorption measurements are graphed as functions of partial pressure and water concentration. It is observed that the sorption isotherms obtained over the temperature range from 27° to 40°C are essentially superimposable indicating that the heat of mixing is virtually zero for water in this polyurethane. An observed decrease in the diffusion constant with increasing water concentration is reported to be due to the immobilization of an increasing fraction of the water in clusters. A.G.O.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-16885# RAND Corp., Santa Monica, Calif.
AN INITIAL VALUE METHOD FOR FREDHOLM INTEGRAL EQUATIONS OF CONVOLUTION TYPE
H. H. Kagiwada and R. E. Kalaba Nov. 1966 25 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5186-PR; AD-642121) CFSTI: HC $3.00/MF $0.65

A method is given for converting Fredholm integral equations into systems of ordinary differential equations that can be readily solved by modern analog and digital computers. Author (TAB)

N67-16894# RAND Corp., Santa Monica, Calif.
THE TERMINATION OF CERTAIN ITERATIVE PROCESSES
R. M. Needham Nov. 1966 11 p refs
(Contract AF 46(638)-1700; Proj. RAND)
(RM-5188-PR; AD-641667) CFSTI: HC $3.00/MF $0.65

This note demonstrates that a certain class of iterative processes must terminate. The processes in question arise mostly in automatic classification (or botryology as it is sometimes called), and are used for finding clusters of points or objects in a wide variety of spaces. Empirical termination or convergence (the terms are loosely used) has been observed frequently, but there seems to lack a general statement as to why. TAB

N67-16928# Ballistic Research Labs., Aberdeen Proving Ground, Md.
STEPWISE MULTIPLE REGRESSION STATISTICAL THEORY AND COMPUTER PROGRAM DESCRIPTION
Harold J. Breaux, Lloyd W. Campbell, and John C. Torrey Jul. 1966 49 p refs
(BRL-R-1330; AD-639955) CFSTI: HC $3.00/MF $0.65

Multiple regression is a least squares statistical technique for quantitatively estimating an empirical linear relationship which may exist between variables. The classical approach often encounters acute computational difficulty, especially when many variables are involved and when little is known about the form of an appropriate functional linear model to represent the data. This can be overcome by using the technique of Stepwise Multiple Regression. The basic idea of the technique is that it allows one to overestimate the complexity of the candidate linear model which is to be statistically analyzed. From this model a statistically significant sub-model is determined by using certain criteria of fit and tests of significance to eliminate insignificant terms. Author (TAB)

N67-17033# Stanford Univ., Calif. Dept. of Statistics.
A STOCHASTIC *A POSTERIORI* UPDATING ALGORITHM FOR PATTERN RECOGNITION
John Van Ryzin (Argonne Natl. Lab.) 1 Oct. 1966 35 p refs
(Contract Nonr-225(52))
(TR-121; AD-642612) CFSTI: HC $3.00/MF $0.65

The pattern recognition problem is viewed as a sequential two-class classification problem. An algorithm is given which updates the a posteriori distribution of membership in one class at stage n+1 based on the previous n observations and their respective classifications. This updated estimate of the a posteriori distribution is then used to classify the n+1st observation. It is shown that under very general assumptions on the distributions involved the expected squared-error of the estimated a posteriori distribution and true a posteriori distribution conditional on the past observations and classifications approaches zero in probability as the number of past observations increases. From this result it is shown that the probability of misclassification using the estimated rule conditional on the past observations approaches in probability the minimal probability of misclassification using the optimal Bayes rule. Comparisons with other algorithms in the literature are also discussed. Author (TAB)

N67-17107*# Michigan Univ., Ann Arbor.
ARITHMETIC ERROR CORRECTION
Harvey L. Garner *In* NASA. Electron. Res. Center Spaceborne Multiprocess. Seminar 31 Oct. 1966 p 51-57 refs (See N67-17101 07-08) CFSTI: HC $3.00/MF $0.65

The classification and properties of arithmetic codes is briefly reviewed. The application of the theory of error checking and correction to practical computers has been limited because of the effects of error checking on computation rate or because of the relative complexity of error control circuits in comparison with arithmetic circuitry. It is possible that some applications of error codes have lead to a less reliable overall unit because of the complexity of the error control equipment. In this paper a new logical circuit for the determination of the modulo 3 residue is presented and the expected performance of this circuit is analyzed, assuming that the error events follow a binomial distribution. The modulo 3 check circuit operates faster than the conventional adder carry logic and the statistical analysis indicates that the circuit is practical. Author

N67-17114# Brandeis Univ., Waltham, Mass. Dept. of Mathematics.
[ONR RESEARCH ASSOCIATES' ACTIVITIES] Final Technical Report, 1 Jul. 1965-30 Jun. 1966
15 Jun. 1966 27 p refs
(Contract Nonr-5152(00))
(AD-641853) CFSTI: HC $3.00/MF $0.65

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3. TWO THEOREMS ON GALOIS COHOMOLOGY M. I. Rosen 5 p refs (See N67-17117 07-19)

N67-17115# Brandeis Univ., Waltham, Mass. Dept. of Mathematics.
THE MODULAR GROUPS OF HILBERT AND SIEGEL
William F. Hammond *In its* [ONR Res. Associates' Activities] 15 Jun. 1966 7 p refs (See N67-17114 07-19) CFSTI: HC $3.00/MF $0.65

Discussed are algebraic families of polarized abelian varieties which are fibered over automorphic varieties. Families correspond, roughly, to certain analytic mappings of automorphic varieties (the base varieties) into the Siegel modular variety. It is our intention here to discuss the case of Hilbert's modular variety. On the one hand, in order to produce results, we shall introduce data which are more restrictive than data for the construction of a fiber variety. On the other hand, this is not exactly a special case since the base variety is compact and non-singular. One hopes that the fiber systems constructed from our data will turn out to be algebraic. After the discussion of our data, which are called modular imbeddings, the structure of two "quadratic" Hilbert modular varieties is

determined as a consequence of the existence of modular imbeddings. Author

N67-17116# Brandeis Univ., Waltham, Mass. Dept. of Mathematics.
THE JACOBSON RADICAL OF A GROUP ALGEBRA
Michael I. Rosen *In its* [ONR Res. Associates' Activities] 15 Jun. 1966 9 p refs (See N67-17114 07-19) CFSTI: HC $3.00/MF $0.65

Let K be a field of characteristic zero, and G a group. It has been conjectured that the group algebra K[G] is semi-simple, i.e., that the Jacobson radical of K[G] is zero. If K has elements which are transcendental over Q, the rational numbers, then indeed K[G] is semi-simple. When K is algebraic over Q only partial results are known. For example, if G is abelian, or G/C is locally finite, C being the center of G, then the conjecture is known to be true. We shall give new proofs of these results, and verify the conjecture for a much larger class of groups. Author

N67-17117# Brandeis Univ., Waltham, Mass. Dept. of Mathematics.
TWO THEOREMS ON GALOIS COHOMOLOGY
Michael I. Rosen *In its* [ONR Res. Associates' Activities] 15 Jun. 1966 5 p refs (See N67-17114 07-19) CFSTI: HC $3.00/MF $0.65

The Galois comohology group of the ring of integers in algebraic number fields was studied by proving generalizations of the following theorems: (1) If both K and k are Galois over the rationals Q, and G is cyclic of prime order, then $H^m(G,O_K) - H^n(G,O_K)$ for all intergers m and n; and (2) if G is a cyclic group, and no infinite prime of k is ramified in K, and if ord G=n, then n ord $H^{2r}(G,U_K)$ = ord $H^{2s+1}(G,U_K)$ for all integers r and s. The hypothesis about no infinite prime ramifying was satisfied when K was totally real, or when N was odd. G.G.

N67-17153# Naval Weapons Lab., Dahlgren, Va.
A METHOD FOR COMPUTING THE INCOMPLETE BETA FUNCTION RATIO
A. R. DiDonato and M. P. Jarnagin, Jr. Oct. 1966 70 p refs Revised
(NWL-1949; AD-642495) CFSTI: HC $3.00/MF $0.65

An efficient method is given for computing the incomplete beta function ratio I sub x(a,b), on a high speed digital computer. The arguments a,b, are limited to positive integral multiples of one-half values over the ranges $1/2 < a < 10$ to the 8th, $1/2 < b < 60$. The program has been coded in STRAP for the IBM 7030 (STRETCH). The average computing time for a ten decimal digit value of I sub x(a,b) is 2.6 milliseconds; on an IBM 7090 it would be about 8 milliseconds per case. Author (TAB)

N67-17221# Wisconsin Univ., Madison. Mathematics Research Center.
TALKS ON GENERALIZED INVERSES AND SOLUTIONS OF LARGE, APPROXIMATELY SINGULAR LINEAR SYSTEMS
Apr. 1966 98 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-644; AD-638657) CFSTI: $3.00/MF $0.65

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3. REMARKS ON FOUR METHODS FOR COMPUTING A^+b L. D. Pyle p 9–24 refs (See N67-17224 07-19)

4. PARTITIONING | AND TEARING | LARGE SYSTEMS OF EQUATIONS D. V. Steward p 25–32 ref (See N67-17225 07-19)

5. A SIMPLE METHOD FOR THE SOLUTION OF BADLY-CONDITIONED LEAST-SQUARES EQUATIONS B. Noble p 33–38 ref (See N67-17226 07-19)

6. CHEBYSHEV SOLUTION OF LARGE LINEAR SINGULAR AND/OR INCONSISTENT SYSTEMS J. B. Rosen p 39–40 ref (See N67-17227 07-19)

7. REMARKS ON GREVILLE'S METHOD FOR FORMING A^+ R. E. Cline p 41–44 refs (See N67-17228 07-19)

8. LEAST SQUARES APPROACH WITH ORTHOGONAL HOUSEHOLDER TRANSFORMATION C. Y. Cho p 45–48 refs (See N67-17229 07-19)

9. NOTES ON THE NUMERICAL SOLUTION OF SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS B. Noble p 49–85 refs (See N67-17230 07-19)

N67-17222# Wisconsin Univ., Madison. Mathematics Research Center.
GENERALIZED INVERSES
T. N. E. Greville *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 1–3 ref (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

The basic properties of the generalized inverse of a matrix are outlined. Various theorems are presented, and the weak generalized inverse is mentioned. N.E.N.

N67-17223# Wisconsin Univ., Madison. Mathematics Research Center.
A METHOD FOR COMPUTING THE GENERALIZED INVERSE OF A MATRIX
Ben Noble *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 4–8 refs (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

Fundamental formulas involving only one inversion are developed for the computation. The Gauss–Jordan procedure is extended to provide a convenient method for finding the required matrices, and an illustration of the method is included. N.E.N.

N67-17224# Wisconsin Univ., Madison. Mathematics Research Center.
REMARKS ON FOUR METHODS FOR COMPUTING A + B
L. D. Pyle *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 9–24 refs (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

Two of the methods discussed are iterative, and the other two are direct. One direct method is an elimination method in which A^*A is formed and elimination is performed on the augmented matrix. This method requires explicit formation and determination of the rank of A^*A (or AA^*). The second method discussed is iterative in nature, and is essentially Newton's method applied to the determination of A^+. In the third method an orthonormalization process is applied to both the colums of A^* and of A^+, obtaining two orthonormal sets of vectors which are used in certain recursion relations yielding either A^+ or A^+b. In the final method, iterative type, simple projection matrices are formed using the columns

and rows of A and a sequence of vectors is determined converging to a vector which lies in the intersection of the ranges of the projectors. N.E.N.

N67-17225# Wisconsin Univ., Madison. Mathematics Research Center.
PARTITIONING AND TEARING LARGE SYSTEMS OF EQUATIONS
Donald V. Steward *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 25–32 ref (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

Systematic methods for extracting information from the structure of the equations are illustrated. An example of partitioning and tearing a specific matrix, in which the equations may be nonlinear, is presented. Partitioning is defined as determining the blocks, or subsets of the set of equations, which must be solved simultaneously in such a way that the blocks can be solved sequentially. The method is described, and charts are included. It is pointed out that the algorithm for partitioning is very fast and that the computing time does not rise rapidly with the size of the problem, although the computing time for the tearing algorithm does. N.E.N.

N67-17226# Wisconsin Univ., Madison. Mathematics Research Center.
A SIMPLE METHOD FOR THE SOLUTION OF BADLY-CONDITIONED LEAST-SQUARES EQUATIONS
Ben Noble *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 33–38 ref (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

The least squares solution of the set of equations $Ax=b$ is defined to be the solution which minimizes the sum of the squares of the residuals $r=b-Ax$. The least squares solution is given by $A^TAx=A^Tb$. Because it is difficult to find x from this solution, as these solutions are often extremely sensitive to rounding errors, a method is suggested for arranging the calculations in a manner so that it is possible to minimize the sensitivity of the calculation to rounding errors. L.E.W.

N67-17227# Wisconsin Univ., Madison. Mathematics Research Center.
CHEBYSHEV SOLUTION OF LARGE LINEAR SINGULAR AND/OR INCONSISTENT SYSTEMS
J. B. Rosen *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 39–40 ref (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

Consideration is given to a large linear system $Ax=b$, where A is an $n \times m$ matrix with $m \leq n$. It is pointed out that in using a least squares solution difficulties arise if the normal equations are singular, or almost singular. Also, if such a solution is obtained it will be unstable with respect to perturbations in the elements of A. A method is proposed to find a solution to such a system that is stable with respect to small changes in the matrix elements by finding a solution x to the system $Ax-b=\delta$, which minimizes δ in the Chebyshev norm such that each component of x is bounded in magnitude by a specified constant. On the basis of several numerical tests, it was found that the Chebyshev solution is relatively insensitive to small perturbations in the elements of A. L.E.W.

N67-17228# Wisconsin Univ., Madison. Mathematics Research Center.
REMARKS ON GREVILLE'S METHOD FOR FORMING A+
R. E. Cline *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 41–44 refs (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

Greville's method for forming A^+, which is a sequential procedure for building up the generalized inverse of a matrix, is given, and numerically examples are included. Pertinent comments on the method and examples are also given. L.E.W.

N67-17229 Wisconsin Univ., Madison. Mathematics Research Center.
LEAST SQUARES APPROACH WITH ORTHOGONAL HOUSEHOLDER TRANSFORMATION
C. Y. Cho *In its* Talks on Generalized In Verses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 45–48 refs (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

An illustration is given for an orthogonal matrix which includes a triangular matrix. The construction of the orthogonal matrix is also presented. N.E.N.

N67-17230# Wisconsin Univ., Madison. Mathematics Research Center.
NOTES ON THE NUMERICAL SOLUTION OF SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS
Ben Noble *In its* Talks on Generalized Inverses and Soln. of Large, Approximately Singular Linear Systems Apr. 1966 p 25–32 refs (See N67-17221 07-19) CFSTI: HC $3.00/MF $0.65

Problems involved in solving systems of linear equations by digital computer are discussed, using the system $Ax=b$, where A and b are known exactly. It is considered that for dense matrices with no special structure, the simplest and best method for solving is the classical method of successive elimination, provided that the pivots are suitably chosen. An illustration is given, and the choice of pivots, partial or complete, is emphasized. Solutions to well-behaved and ill-conditioned sets of two equations in two unknowns are described. Rounding errors are discussed in detail, and a convenient iterative method for improving the accuracy of an approximate solution is described. Numerical examples are included. N.E.N.

N67-17246*# Wisconsin Univ., Madison. Dept. of Statistics.
CONSTRUCTION OF THE UNIQUE SATURATED RESOLUTION V DESIGN IN 256 RUNS
Norman R. Draper and Toby J. Mitchell Aug. 1966 20 p refs Sponsored in Part by NASA
(Contract Nonr-1202(17))
(TR-81; AD-641397) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The paper investigates the problem of how many variables can be accommodated in a 2 sub v k-p design in 256 runs. The problem is solved through the application of methods given by the authors in a previous paper (Draper and Mitchell (1966)) to the particular case R = 5, q = k - p = 8. The problem of obtaining optimally blocked designs for each value of k is also solved. Author (TAB)

N67-17266 Chicago Univ., Ill. Inst. for Computer Research.
ON THE CONVERGENCE ON AN ACCELERATED ITERATIVE METHOD IN THE SOLUTION OF SINGULAR EQUATIONS
W. V. Petryshyn *In its* ICR Quart. Rept., No. 9 1 May 1966 6 p refs (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

An accelerated iterative method for solving singular equations is presented in contrast to the ordinary iterative method, which converges rather slowly. A linear equation with a nonself-adjoint bounded operator is solved, and proof of an elementary character is given. S.P.

N67-17267 Chicago Univ., Ill. Inst. for Computer Research.
FURTHER REMARKS ON NONLINEAR P-COMPACT OPERATORS IN BANACH SPACE
W. V. Petryshyn *In its* ICR Quart. Rept., No. 9 1 May 1966 9 p refs (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

Consideration is given to the existence and the construction of solutions and fixed points for nonlinear equations involving bounded projectionally-compact (P-compact) operators defined on a real Banach or Hilbert space with a basis. Results are extended to (a) P-compact operators without assuming their boundedness, and (b) studies concerning the solvability of nonlinear equations and the geometrical intersection theorem involving quasibounded completely continuous operators. At the same time some new results are obtained for P-compact and monotone operators in Hilbert space. S.P.

N67-17330*# California Univ., Los Angeles.
ELEMENTS OF CALCULUS OF VARIATIONS AND OPTIMUM CONTROL THEORY
Magnus R. Hestenes *In* Wis. Univ. Lectures in Appl. Math. Vol. VI 1966 p 212-254 refs (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

The calculus of variations and optimum control theory, along with certain associated computational methods, is presented in parallel format to show basic similarities. The two theories together form one theory, with separate vocabularies arising from usage current to its era of development. Considered is the following problem in classical calculus of variations, namely a bead on a frictionless wire falling under the influence of gravity, commonly called the brachistochrone problem; find the path of least time between points 1 and 2 for a bead of mass m sliding along the wire under the influence of gravity alone. Author

N67-17342# California Univ., Los Angeles. Western Management Science Inst.
TWO SHORT NOTES ON MARKOV PROCESSES: I: A TEST FOR SUB-OPTIMAL ACTIONS IN MARKOVIAN DECISION PROBLEMS.
James B. MacQueen Sep. 1966 13 p refs *Its* Working Paper No. 107
(Contract Nonr-233(75))
(AD-641195) CFSTI: HC $3.00/MF $0.65

CONTENTS:
1. A TEST FOR SUB-OPTIMAL ACTIONS IN MARKOVIAN DECISION PROBLEMS J. B. MacQueen p 1-4 refs (See N67-17343 07-19)
2. AN INTRINSICALLY DETERMINED MARKOV CHAIN J. B. MacQueen p 5-9 refs (See N67-17344 07-19)

N67-17343# California Univ., Los Angeles. Western Management Science Inst.
A TEST FOR SUB-OPTIMAL ACTIONS IN MARKOVIAN DECISION PROBLEMS
James B. MacQueen *In its* Two Short Notes on Markov Processes Sep. 1966 p 1-4 refs (See N67-17342 07-19) CFSTI: HC $3.00/MF $0.65

In a Markovian decision problem, choice of an action determines an immediate return and the probability of moving to the next state. It is desired to maximize the expected total of discounted future returns. If upper and lower bounds on the optimal expected return are available, a simple test is described which may show that certain actions are sub-optimal, permanently eliminating them from further consideration. This test may be incorporated into the dynamic programming routine for solving the decision problem. This was tried on Howard's automobile replacement problem, using previously described upper and lower bounds. The amount of computation required by the dynamic programming routine was reduced, conservatively, by 75%. Author

N67-17344# California Univ., Los Angeles. Western Management Science Inst.
AN INTRINSICALLY DETERMINED MARKOV CHAIN
James B. MacQueen *In its* Two Short Notes on Markov Processes Sep. 1966 p 5-9 refs (See N67-17342 07-19) CFSTI: HC $3.00/MF $0.65

This paper describes a situation where there is a transient Markov chain with one absorbing state, such that the transition law of the process itself depends on the probability of the process being trapped in the absorbing state. Thus the process is defined implicitly by its own behavior. The existence and uniqueness of a transition law satisfying the given conditions is established. This result may give rise to additional ways of characterizing optimal policies, as is suggested by interpreting the result in terms of the behavior of a gambler. Author

N67-17471# Oak Ridge National Lab., Tenn.
LIKELIHOOD RATIO TEST CRITERION FOR SMALL SAMPLES FROM MULTINOMIAL DISTRIBUTIONS Preliminary Report
V. R. Rao Uppuluri and Kimiko O. Bowman Sep. 1966 52 p refs
(Contract W-7405-ENG-26)
(ORNL-3991) CFSTI: HC $3.00/MF $0.65

The small sample properties of the likelihood ratio test statistic $(-2 \log \Lambda)$ are studied in detail in the case of the trinomial distributions $(1/3 + 1/3 + 1/3)^n$ and $(0.3 + 0.5 + 0.2)^n$. These distributions often appear in the literature in connection with Pearson's χ^2 statistic for n equal to 10 and n equal to 20. A critical review of these papers is given. In order to study the rapidity of convergence of the distribution of the discrete random variable $-2 \log \Lambda$ to the theoretical χ^2 distribution with two degrees of freedom, areas to the right of fixed points 9.210, 7.378, 5.991, 4.605, 2.408, 1.386, 0.713, and 0.211, and the critical values with given tail areas 0.01, 0.025, 0.05, 0.10(0.20) 0.90 are computed for several values of n. To indicate the rapidity of convergence of the sizes of these two test criteria, the 95% acceptance regions are graphically displayed in the case of these two trinomials over a few sample sizes. Another comparison is made in terms of the frequency with which the partitions give rise to the numerical values of the two statistics which will lie between preassigned numbers, and the frequency of partitions, with which the cumulative probability distributions of these two statistics, lies between preassigned numbers. For a given sample size this set of tables indicates the closeness of the distributions of these two statistics to the limiting χ^2 distribution with two degrees of freedom. Author (NSA)

N67-17548# Oak Ridge National Lab., Tenn.
AN ALGORITHM FOR A FORM OF THE PROBLEM $Av = \lambda Bv$
D. E. Arnurius (Ph.D. Thesis—Tenn. Univ.) Sep. 1966 57 p refs
(Contract W-7405-ENG-26)
(ORNL-3980) CFSTI: HC $3.00/MF $0.65

An investigation was made to find a nonnull vector v and an associated scalar λ, real or complex, to satisfy $Av = \lambda Bv$ where B is a positive definite and A is normal with respect to B. A matrix A is normal with respect to the positive matrix B if

case $AB^{-1}A^H = A^HB^{-1}A$. If B = I, the identity matrix, then Av = λ Bv is the proper-value, proper-value problem for a normal matrix A. The problem is written in the form Mv = λ v with $M = B^{-1}A$. An algorithm is described that will provide successive approximations to a proper vector and its associated proper value for the matrix M or provide a sequence of vectors that converges to an invariant subspace τ of M. NSA

N67-17661# RAND Corp., Santa Monica, Calif.
ON THE CONSTRUCTION OF A MATHEMATICAL THEORY OF THE IDENTIFICATION OF SYSTEMS
Richard Bellman Nov. 1966 19 p refs
(Contract AF 49(638)-1700)
(RM-4769-PR; AD-642678) CFSTI: HC $3.00/MF $0.65

The report gives a brief discussion of some of the mathematical techniques used in formulating a theory for system identification. Particular attention is given to the question of how far this domain can be penetrated with relatively simple analytic techniques tailored to the use of a contemporary digital computer. Author (TAB)

N67-17704# Stanford Univ., Calif. Dept. of Statistics.
ROBUSTNESS OF BAYES DECISIONS AGAINST THE CHOICE OF PRIOR
Gustav Elfving 1 Nov. 1966 32 p refs
(Contract Nonr-225(52))
(TR-122; AD-642613) CFSTI: HC $3.00/MF $0.65

The present paper is an attempt at a quantitative evaluation of the approximation that the outcome - in terms of utility or loss - of any Bayes decision procedure may, for large samples, be expected to become insensitive to the choice of prior distribution. More precisely, the author investigates the asymptotic behavior of the difference in loss when using two arbitrary priors, the said difference being evaluated for a fixed true state of nature, consistent with both priors. Under appropriate regularity and identifiability conditions, it turns out that the difference, asymptotically, consists of an error term (a random term with expectation 0) of order n to the -3/2, and a systematic term of order n to the -2. The coefficients depend on the data of the problem, i.e., on the sampling distribution, the loss function, and the priors, in a way indicated, and the subsequent Corollary. He treats only the case of one-dimensional and continuous state and action spaces (for instance, estimation of a single parameter). The case of several parameters seems to offer no essential additional difficulties, provided that the parameter vector (or the relevant component of it) is identifiable under the sampling distribution. The case of discrete decisions (like in testing) offers technical difficulties and may lead to quite different asymptotic properties of the loss. Author (TAB)

N67-17709# Florida State Univ., Tallahassee. Dept. of Statistics.
MULTIVERIATE PAIRED COMPARISONS
Ralph A. Bradley and Roger R. Davidson Sep. 1966 112 p refs
(Contract Nonr-988(08))
(FSU-M121; ONR-22; AD-641857) CFSTI: HC $3.00/MF $0.65

The study concerns itself with the development of an extension of the Bradley-Terry model for paired comparisons to situations in which responses to paired comparisons are obtained on each of several characteristics. A discussion of several possible approaches to an appropriate model is given and a model is selected. An iterative procedure for obtaining maximum likelihood estimates of the parameters introduced into the model is proposed and its behavior examined in some detail. Test procedures are developed for several tests of interest including a test of the appropriateness of the model. An extensive treatment of the asymptotic properties of the model closely parallels that which has been given for the univariate case by R. A. Bradley (1955). Rank analysis of incomplete block designs. III. Some large-sample results on estimation and power for a method of paired comparisons. (Biometrika 42, 450-470). Two numerical examples are given to illustrate the procedures which have been developed. Author (TAB)

N67-17718# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS IN THE THEORY OF PROBABILITY AND MATHEMATICAL STATISTICS
A. N. Kolmogorov 8 Dec. 1966 9 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 5, 1965 p 94-96
(FTD-HT-66-289; AD-643595) CFSTI: HC $3.00/MF $0.65

This is a survey of research in the theory of probability. The works of several scientists in this field are cited. The Markovian process is discussed. The application of mathematics to the different scientific fields is cited. Author (TAB)

N67-17730# Argonne National Lab., Ill.
CONJUGACY TO UNITARY GROUPS WITHIN THE INFINITE-DIMENSIONAL SYMPLECTIC GROUP
Irving E. Segal Jun. 1966 11 p refs
(Contract W-31-109-ENG-38)
(ANL-7216) CFSTI: HC $3.00/MF $0.65

The characterization of Cook for stable, amenable, symplectic groups in an infinite-dimensional space is sharpened and reformulated so as to be applicable in part to arbitrary groups. Author (NSA)

N67-17825*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE CONJUGATE POINT AND DYNAMIC PROGRAMMING
W. G. Melbourne 15 Sep. 1966 17 p refs
(Contract NAS7-100)
(NASA-CR-81638; JPL-TR-32-1043) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The continuity properties of the second partials of the optimal performance function S(x,y) play a crucial role in making the transition from the recursive formulation of the principle of optimality of dynamic programming to the Hamilton-Jacobi equation and to the Euler and Weierstrass necessary conditions of the calculus of variations. At a singularity point of an extremal, S_{yy} has a first-order pole. The asymptotic properties of S_{yy} near a pole are discussed and used to demonstrate the necessity of the boundedness of S_{yy} on the interior of a minimizing extremal. A one-to-one relationship is demonstrated between a pole of S_{yy} on the interior of an extremal and the conjugate points as classically defined in the calculus of variations. The geometric properties of envelopes and the envelope theorem are reviewed. It is shown that when the end point of an extremal is sufficiently close to an envelope, such an extremal is not a globally minimizing curve. Author

N67-17853*# Houston Univ., Tex.
CONCERNING METRIZATION AND SEPARATION IN NORMAL, SEPARABLE MOORE SPACES
D. Reginald Traylor [1964] 12 p refs Submitted for Publication
(Grant NGR-44-005-010)
(NASA-CR-70112) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Stated is the conjecture: suppose that S is a connected, normal Moore space such that S contains no cut points and it is true that if each of P and Q is a point of S and R is a region containing P, then some separable, closed, connected subset N of R separates P from Q in S. Then S is separable. The purpose of

the paper is to answer the conjecture in the negative, provided a normal, separable, nonmetrizable Moore space exists. It follows that, should the conjecture be found true, it thus would remove the condition of the continuum hypothesis from a previously obtained result to the effect that each normal, separable Moore space is metrizable under certain conditions. K.W.

N67-17873*# Duke Univ., Durham, N. C. Dept. of Mathematics.
A PROPERTY OF THE ORDER STATISTICS OF AN EXPONENTIAL VARIATE
Trevor Williams [1961] 6 p refs Submitted for Publication
(Grant NGR-34-001-005)
(NASA-CR-70246) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The results from estimating the scale of an exponential distribution of known location are discussed. The technique used is that of a previously published method of estimating the scale and location of a random variable by forming the best linear unbiassed estimate based on its order statistics. It is shown that the information relevant to the scale is concentrated markedly in the upper portion of the sample, with a logarithmic type of singularity such that the upper half of the sample contains 98.0% of the total information; the upper tenth, 68.9%; and the upper hundredth, 22.4%. N.E.N.

N67-17874* Purdue Univ., Lafayette, Ind.
A PROPERTY OF THE L_2-NORM OF A CONVOLUTION
Douglas R. Anderson [1965] 6 p ref
(Grant NsG-553)
(NASA-CR-69940) CFSTI: HC $3.00 CSCL 12A

The work concerns optimum binary signal sets for certain scatter-multipath channel models. The convolution of two members, f and g, of $L_2(-\infty, +\infty)$ can be a null function without either f or g being a null function. But if f_ν is defined by setting $f_\nu(x) = e^{i\nu x} f(x)$ for all x, f_ν and g will have a convolution that is not a null function for a suitable choice of ν. The present paper provides a partial answer to the problem of how the L_2-norm of the latter convolution depends on ν. Author

N67-17903# Air Force Academy, Colo. Frank J. Seiler Research Lab.
QUADRATIC CONTROL PROBLEM WITH AN ENERGY CONSTRAINT APPROXIMATE SOLUTIONS
Gerald Cook and James Funk Oct. 1966 32 p refs
(SRL-66-0008; AD-643495) CFSTI: HC $3.00/MF $0.65

The quadratic control regulator problem with an energy constraint has been investigated from the viewpoint of having limited control energy available or as an indirect method of limiting the maximum control amplitude. The solution of this problem requires iteration on a parameter and therefore is not as straightforward to apply as the well known Kalman result where no constraints are imposed. However it is much simpler than the problem where control amplitude constraints are applied directly for which case one must iterate on an n dimensional vector. Also for the systems studied it was found that the parameter has a regular behavior as a function of initial state and that this behavior could be approximated by empirical equations. Therefore, the control law could be approximately known for all initial conditions without iterating. Three specific cases were considered in the numerical evaluation portion of the study: harmonic oscillator, single integrator with damping and double integrator. The numerical results indicated that constraining control energy did tend to constrain maximum control amplitude. Author (TAB)

N67-17908# Purdue Univ., Lafayette, Ind.
ON THE PROBLEM OF RANKING AND SELECTION FROM k FIXED POPULATIONS
William J. Studden Aug. 1966 27 p refs Mimeograph Ser. No. 89
(Contracts Nonr-1100(26); AF 33(657)-11737)
(AD-639718) CFSTI: HC $3.00/MF $0.65

The problem of defining optimal subset selection rules is investigated for the case in which there are k fixed density functions and only the correct pairing of the densities and populations is known. Most of the results concern the problem of minimizing the expected size of the selected subset under the condition that the best population is selected with a prescribed probability. The method employed relies on a simple reduction procedure, involving the usual symmetry conditions, which permits the application of standard results in the theory of testing hypothesis. A formulation and solution of the general problem are given, and the solution for the exponential family when the parameters are in a slippage-type configuration is examined. A sequence of procedures is considered, and it is shown that the classical procedures appear in certain limiting cases. The case of two normal populations with variance one and the mean as parameter is then discussed, and scale invariant procedures for gamma type populations are considered. L.E.W.

N67-17911# Research Analysis Corp., McLean, Va.
THE SLACKED UNCONSTRAINED MINIMIZATION TECHNIQUE FOR CONVEX PROGRAMMING
Anthony V. Fiacco and Garth P. McCormick Aug. 1966 22 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-227; AD-643817) CFSTI: HC $3.00/MF $0.65

An algorithm for solving the problem: minimize f (x) (a convex function) subject to g sub i (x) or = 0, i = 1, . . . , m (g sub i a concave function) is presented. Specifically the function P(x,t,r sub k) is identical with f(x) + 1/r sub k sigma (g sub i (x) - t sub i)squared is minimized over all x, nonnegative t, for a strictly decreasing null sequence (r sub k). It is proved that for every r sub k > 0, there exists a finite point (x (r sub k), t(r sub k)) which minimizes P and solves the convex programming problems as r sub k approaches 0. This algorithm is similar to the Sequential Unconstrained Minimization Technique (SUMT) found in a work by Fiacco and McCormick, in that it solves Wolfes dual programming problem. It differs from SUMT in that (a) it approaches the optimum from the region of infeasibility (i.e., it is a relaxation technique), (b) it does not require a nonempty interior to the nonlinearly constrained region, (c) no separate feasibility phase is required before optimization takes place, and (d) the computational effort to solve the problem drastically reduced. Author (TAB)

N67-17912# Research Analysis Corp., McLean, Va.
THE SEQUENTIAL UNCONSTRAINED MINIMIZATION TECHNIQUE WITHOUT PARAMETERS
Anthony V. Fiacco and Garth P. McCormick Aug. 1966 20 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-228; AD-643818) CFSTI: HC $3.00/MF $0.65

For solving convex programming problems an unconstrained minimization technique that involves no parameter selection is presented. The iterations depend only on the initial value of the objective function. Author (TAB)

N67-17918*# Wisconsin Univ., Madison. Dept. of Statistics.
THE CONSTRUCTION OF SATURATED 2_R^{K-P} DESIGNS
Norman R. Draper and Toby J. Mitchell Jul. 1966 37 p refs Supported in Part by NASA
(Contract Nonr-1202(17))
(TR-80; AD-641934) CFSTI: HC $3.00/MF $0.65 CSCL 12A

If a 2k-p design, of fixed resolution R and specified number of runs 2q, accommodates the maximum possible number of variables, the authors say that it is saturated. In this paper, they develop a method for constructing saturated designs and apply it to an example. TAB

N67-17986*# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
A CLASS OF FUNCTIONAL EQUATIONS OF NEUTRAL TYPE
Jack K. Hale and Kenneth R. Meyer Nov. 1966 68 p refs
(Contracts NAS8-11264; Grants NGR-40-002-015; AF-AFOSR-693-66)
(NASA-CR-81665; TR-66-5) CFSTI: HC $3.00/MF $0.65 CSCL 12A

In delay differential equations of neutral type, a difficulty arises because the derivative of a solution occurs with a retardation. This leaves much freedom in selecting the topology on the solution space as well as on the space of initial conditions. The topology must be chosen in such a way as to obtain solutions which are at least continuous with respect to the initial data. A class of functional integral equations in the space of continuous functions is investigated, including certain types of equations of neutral type and some equations which arise in the applications. For this class of equations, precise analogues of the above state properties of ordinary differential equations are obtained. The decomposition of space into invariant subspaces is given in a way that is amenable to computations. Two applications are given to illustrate how the theory of linear equations can be used to study weakly nonlinear systems, and to indicate the possibility of further extensions and applications. The first application is the analogue of a well known stability theorem by first approximation for ordinary differential equations. The second is an extension of the method of integral manifolds to this new class of equations. R.N.A.

N67-18011*# Ohio State Univ., Columbus.
SELECTION FROM MULTIVARIATE NORMAL POPULATIONS
Khursheed Alam (Indiana Univ.) and M. Haseeb Rizvi [1965] 18 p refs Submitted for Publication
(Grant NGR-36-008-040)
(NASA-CR-81722) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The problems of selection and ranking of k non-central chi-squared and non-central F populations, defined in terms of their non-centrality parameters are discussed. Interest is in selecting the t largest of the k populations and a subset containing the t largest for which two procedures, named R_1 and R_2 are given. It is required that the probability of a correct selection using these procedures should be at least as large as any given number $P^* < 1$. This is called the P^* condition. The main part of the problem is to determine the least favorable configurations of the parameter space for which the probability of a correct selection is minimum. The expression for the minimum value determines the smallest sample size needed to satisfy the P^* condition. The least favorable configurations and the corresponding expressions for the minimum of the probability of a correct selection are obtained for R_1 and R_2. Author

N67-18054* Tennessee Univ., Knoxville.
ON THE OSCILLATION OF SOLUTIONS OF CERTAIN SELF-ADJOINT LINEAR DIFFERENTIAL EQUATIONS OF THE FOURTH ORDER
Robert Caldwell Clark (M.A. Thesis) Aug. 1966 28 p refs
(Grant NGR-43-001-029)
(NASA-CR-81702) CFSTI: $3.00 CSCL 12A

This paper investigates the oscillatory properties of solutions to certain self-adjoint linear differential equations of the fourth order. It is shown that the results of the theorem that an equation in F is oscillatory if, and only if, for every $a > 0$ there exists an infinity of conjugate points $\eta_p(a)$, can be obtained under weaker hypothesis than assumed there. Author

N67-18068# European Atomic Energy Community, Ispra (Italy) Scientific Information Processing Center.
LECTURES ON "RIESZ SPACES"
A. C. Zaanen and R. F. Gloden, ed. Brussels, EURATOM, Oct. 1966 72 p Lectures given at the Univ. of Leyden, 4–21 Apr. 1966
(EUR-3140.e) CFSTI: HC $3.00/MF $0.65

A sequence of lectures on functional analysis is presented. The present lectures are devoted to the theory of Riesz spaces (linear vector lattices). Author

N67-18088*# Texas A&M Univ., College Station. Dept. of Mathematics.
A THIRD-ORDER AND A FOURTH ORDER ITERATION PROCESS FOR NON-LINEAR EQUATIONS
H. A. Luther and A. R. Crawley [1966] 8 p ref
(Grant NGR-44-001-024)
(NASA-CR-81744) CFSTI: HC $3.00/MF $0.65 CSCL 12A

First-order derivatives are used to build the Newton–Raphson second-order iteration. By adding certain functions involving also second-order derivatives, a third-order process is built. By adding certain functions involving, in addition, third-order derivatives, a fourth-order process is built. A program has been written making any choice (as well as a first-order process) available for any system of equations for which the requisite derivatives can be evaluated. Author

N67-18108# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
SEQUENTIAL SELECTION OF THE BEST OF k POPULATIONS
J. J. Deely Aug. 1966 23 p refs Prepared in cooperation with Sandia Corp. /ts Mimeo. Ser. No. 91
(Contract AF 33(657)-11737)
(AD-640479) CFSTI: HC $3.00/MF $0.65

In selecting the best of k populations, the case in which k approaches infinity is considered; and various stopping rules are obtained that maximize the expected payoff by assuming that the unknown parameter is bounded by some real number, has the same a priori distribution G, or an a priori distribution of G_t. Explicit rules are given for two specific payoff functions, and mathematical formulation and definitions are detailed. The maximum stopping rule and minimax configuration is viewed as a two person zero sum game, and Bayes stopping rules are detailed. Ordering is assumed a random permutation so that even if the unknown parameters were known, the exact location of the largest one would still be unknown; and the random variables are observed sequentially until stopping takes place. M.W.R.

N67-18159*# Connecticut Univ., Storrs.
CONTROL OF NONLINEAR MULTIVARIABLE SYSTEMS
D. P. Lindorff Washington, NASA, Feb. 1967 27 p refs
(Grant NsG-309)
(NASA-CR-716) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The control concept is rooted in Liapunov's direct method, which is extended so as to be applicable to nonlinear plants with

inequality constraints on the controlled forces. The basic control configuration is shown in which a multivariable plant is caused to track a model through the action of a fixed-law controller. The design of the controller is to be such as to cause the error to be bounded. A design example of the control of an exothermic chemical reactor is used to illustrate an application of the technique. The multivariable problem is developed so as to be applicable to a more general class of nonlinear systems with inequality constraints on the control forces. With given limits on the amplitudes of the controlled forces, a region of the plant state space can be found in which the control law is valid, the size of this region being a function of certain of the model states. A novel feature of the method relates to nonlinear constraints which may be placed on the model to guarantee validity of the control law within a specified region of the state space. Author

N67-18181*# Ohio State Univ. Research Foundation, Columbus.
RANKING PROBLEMS IN MULTIVARIATE NORMAL (STATISTICAL) POPULATIONS Semiannual Progress Report No. 1, 1 Jul.–31 Dec. 1966
M. Haseeb Rizvi 9 Jan. 1967 3 p
(Grant NGR-36-008-040)
(NASA-CR-81773) CFSTI: HC $3.00/MF $0.65 CSCL 12A

It is reported that differential difference equations involving noncentral chi-square (noncentral F) distribution and density functions were obtained for solving the minimization problem in investigations of selection from multivariate normal populations. It is noted that these can be of use in problems of obtaining extrema of functions involving noncentral chi-square (noncentral F) distribution and density functions. Also reported is that work on numerical computations for making suitable tables to be used in conjunction with this investigation is continuing. C.T.C.

N67-18187*# Texas A&M Univ., College Station. Dept. of Mathematics.
EQUATIONS FOR RUNGE–KUTTA FORMULAS THROUGH THE EIGHTH ORDER
H. A. Luther and J. A. Smitherman [1965] 53 p refs
(Grant NGR-44-001-024)
(NASA-CR-81802) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Tables are presented of the elementary weights for the Runge–Kutta formulas of the first eight orders and of the Runge–Kutta relations for explicit formulas through order seven. The expressions considered are both explicit and implicit, with the differential system taken as $dy/dx = f(x,y)$, with $y(x_0) = y_0$. In this system y is a column matrix of length m, as is f(x,y), so that m simultaneous first order ordinary equations are considered in the variable x. C.T.C.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-16780# Environmental Science Services Administration, Washington, D. C. Meteorological Satellite Lab.
EXPERIMENTAL USE OF SATELLITE PICTURES IN NUMERICAL PREDICTION, PART II
Harold J. Brodrick, E. Paul McClain, and Mary Ann Ruzecki Jan. 1966 28 p refs
(Rept.-36; PB-169913) CFSTI: HC $3.00/MF $0.65

Part I of this report, published previously gave the basis and description of an experimental technique for modifying 500-mb stream fields in data-sparse areas on the basis of satellite data. The usefulness of the reanalysis method was assessed by comparing 36-hour barotropic forecasts based on both modified and unmodified initial fields. Verification statistics were presented for five developmental cases, although details of reanalysis were given for only one of these. Part II, presented here, presents the details of the remaining four cases. Also set forth are some general guidelines for analysis modification based on interpretation of cloud patterns viewed in satellite photographs. Technical problems involved in introducing analysis changes and evaluation of the effects of such changes are discussed. Author (TAB)

N67-16895*# National Severe Storms Lab., Norman, Okla.
NOTES ON THUNDERSTORM MOTIONS, HEIGHTS, AND CIRCULATIONS
Nov. 1966 58 p refs Sponsored by NASA and FAA Prepared jointly with the Brit. Meteorol. Office
(NASA-CR-81439; NSSL-29) CFSTI: HC $3.00/MF $0.65 CSCL 04B

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2. MOTION AND INTENSITY CHARACTERISTICS OF THE SEVERE THUNDERSTORMS OF APRIL 3, 1964 K. E. Wilk p 9–21 refs (See N67-16897 07-20)

3. AN ANALYSIS OF EIGHT FLIGHTS BY U-2 AIRCRAFT OVER SEVERE STORMS IN OKLAHOMA W. T. Roach p 23–51 refs (See N67-16898 07-20)

N67-16896*# National Severe Storms Lab., Norman, Okla.
A NOTE ON THE DEVELOPMENT AND MOVEMENT OF STORMS OVER OKLAHOMA ON MAY 27, 1965
T. W. Harrold (Meteorol. Office, Malvern, Engl.) *In its* Notes on Thunderstorm Motions, Heights, and Circulations Nov. 1966 p 1–8 refs (See N67-16895 07-20) CFSTI: HC $3.00/MF $0.65

Two tornadic storms developed near the Texas–Oklahoma border on May 27, 1965. These storms diverged markedly for several hours, one moving 30° to the right and the other 30° to the left of the mean wind over the cloud depth. A detailed examination of the PPI radar data at 1-min. intervals showed that some individual cells, as well as the larger storm area, were diverging. The Kutta–Joukowski force is considered as a possible factor in the movement, and it is also noted that the movement to the right of the wind could have resulted from continuous propagation toward the moisture supply. The highest storm top, as observed from an aircraft in the vicinity, was higher than that predicted from the parcel theory of convection. This may indicate a significant release of latent heat of fusion within the storm. Author

N67-16897*# National Severe Storms Lab., Norman, Okla.
MOTION AND INTENSITY CHARACTERISTICS OF THE SEVERE THUNDERSTORMS OF APRIL 3, 1964
Kenneth E. Wilk *In its* Notes on Thunderstorm Motions, Heights, and Circulations Nov. 1966 p 9–21 refs (See N67-16895 07-20) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Objective techniques are used for analysis of five severe thunderstorms which occurred on April 3, 1964 in Oklahoma and

Texas. The radar reflectivities and velocities of the storms are presented and the differences among storms are discussed. The average motion of all storms corresponds to the mean layer wind from the surface to 8 km; however, the range of individual velocities is as large as the mean. Differences in direction of motion rather than speed, contribute most to this variability. Although velocities vary from storm to storm, the velocity of the individual storm is conservative and provides a suitable basis for short term forecasting. Probability forecasting by objective extrapolation of individual storm positions is discussed. The variability of the storm motions is viewed with respect to recent theories relating storm translation, rotation, and water budget to the environmental wind.
Author

N67-16898*# National Severe Storms Lab., Norman, Okla.
AN ANALYSIS OF EIGHT FLIGHTS BY U-2 AIRCRAFT OVER SEVERE STORMS IN OKLAHOMA
William T. Roach (Meteorol. Office, Bracknell, Engl.) *In its* Notes on Thunderstorm Motions, Heights, and Circulations Nov. 1966 p 23–51 refs (See N67-16895 07-20) CFSTI: HC $3.00/MF $0.65 CSCL 04B

The method and results of the analysis of photographic records of the summit areas of severe storms obtained from a U-2 aircraft flying at an altitude of 65,000 ft. over Oklahoma are described. Comparison of the heights of storm cells protruding through the main anvil cirrus deck of a quall line with the predictions of simple "parcel" theory suggests the latter may be used to indicate the maximum development attainable (but not necessarily attained) by a squall line on a given day. It is suggested that temperatures approaching −100°C may occur in the domes of giant quasi-steady storm cells reaching altitudes of 55,000–60,000 ft. Such a dome is probably bounded by a thin shell of extremely stable air, which is not inconsistent with the rather smooth texture of dome summits sometimes shown by the U-2 photographs.
Author

N67-17013# Naval Research Lab., Washington, D. C.
EVALUATION OF THE USE OF ATMOSPHERIC-ELECTRICITY RECORDINGS IN FOG FORECASTING
R. V. Anderson and Eva Mae Trent 7 Oct. 1966 22 p refs
(NRL-6426; AD-643383) CFSTI: HC $3.00/MF $0.65

Atmospheric electric and meteorological data from four stations were analyzed to determine the accuracy of fog forecasts made using atmospheric electrical recordings. A tabulation indicating the successes and failures in forecasting both fog and no-fog conditions shows success percentages ranging from 86 to 92 percent. These success percentages illustrate the assertion that the use of electrical recordings will effect a material improvement in the accuracy of forecasting. A theoretical discussion leads to the development of a possible physical mechanism for the phenomenon which is consistent with available information. Consideration of human and instrumental factors leads to a decision that a total-conductivity meter using a vibrating-capacitor electrometer and with suppressed-zero checks is the instrument most usable in regular forecasting use.
Author (TAB)

N67-17091# Weather Wing (4th), Ent AFB, Colo. Scientific Services Branch.
PERSISTENCE PROBABILITY Technical Paper No. 66-1
Joe S. Restivo Aug. 1966 41 p refs
(AD-640074) CFSTI: HC $3.00/MF $0.65

The paper consolidates many ideas--both published and suggested--concerning the use of persistence as a practical forecast tool. Specific emphasis is placed on the construction of ceiling and visibility persistence probability (or conditional probability) tables and suggested uses as a short-period forecast aid. The paper contains a survey of published literature available in the technical files of Headquarters, 4th Weather Wing and presents many ideas and suggestions for designing improved probability tables.
Author (TAB)

N67-17095# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
ATMOSPHERIC HUMIDITY ATLAS—NORTHERN HEMISPHERE
I. I. Gringorten, H. A. Salmela, I. Solomon, and J. Sharp Aug. 1966 151 p refs *Its* Surv. in Geophys. No. 186 Also issued as Air Weather Serv. Tech. Rept.-191
(AFCRL-66-621; AD-642429) CFSTI: HC $3.00/MF $0.65

This atlas presents 120 plates showing the distribution of water vapor in the atmosphere of the northern hemisphere. There are 20 plates in terms of mixing ratio at the surface and 100 plates in terms of dew point at the surface and at the 850-, 700-, 500-, and 400-mb levels. The distributions of other measures of moisture, including vapor pressure, frost point, water-vapor density, and mixing ratio aloft, are readily obtainable from the distribution of the dew points. The plates will be useful to designers faced with the problem of estimating the effects of atmospheric water vapor on aerospace hardware and for those concerned with the operation and storage of equipment. The plates of frequency distributions, from 5 to 95%, are especially useful for estimating the duration or persistence of moist conditions, as illustrated by several examples.
Author (TAB)

N67-17316# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
BATTELLE-NORTHWEST RADIO-TELEMETERED METEOROLOGICAL AND RADIATION OBSERVATION NETWORK
P. W. Nickola and E. H. Phinney *In its* Phys. Sci., Vol. I May 1966 p 9–10 refs (See N67-17312 07-13) CFSTI: HC $3.00/MF $0.65

Modifications of the grid consisting of data gathering stations on and peripheral to the Hanford reservation are described. These stations are capable of reporting wind, temperature, and radiation data on an integrated real time basis. The data are then integrated into the regular climatological data acquisition program. Additionally, they are used in various investigations aimed at further definition of local meso-scale circulation schemes. Based on field checks of the validity of wind speeds and directions recorded, the system was judged to be operating within specifications 95% of the time.
A.G.O.

N67-17359*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS, VOL. III Annual Summary Report
R. J. Pilie and W. C. Kocmond Washington, NASA, Feb. 1967 55 p refs
(Contract NASr-156; Proj. Fog Drops)
(NASA-CR-675; ASR-3) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Surface measurements of drop size distribution and liquid water content made in advection fogs are shown to agree with characteristics of the fog model presented in earlier work. Comparisons are made of cloud and fog nucleus concentrations measured in Buffalo, Hawaii and Central Pennsylvania. Analytical and experimental data show that the basic concept for minimizing visibility degradation in radiation fog by preseeding with small concentrations of large hygroscopic nuclei is sound. Visibility improvements greater than a factor of two over unseeded fogs

have been produced in the laboratory. The concept appears to have applicability only for radiation fog situations. Analytic and experimental investigations show that it is impractical to attempt to suppress fog at an airport by placing electric charge on fog droplets. Electrical forces that can be established by this means when practical droplet charging equipment is used are far too small to have significant influence on fog dissipation rate. Author

N67-17631*# Travelers Research Center, Inc., Hartford, Conn.
ENVIRONMENTAL HAZARDS STUDY
Glenn R. Hilst Jan. 1967 77 p refs
(Contract NAS8-11450)
(NASA-CR-61163) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Jet, plume, and thermal phases of rocket exhaust buoyancy are considered; and a simulation approach to vertical diffusion rates in nonuniformly stratified atmospheres is taken to study low level atmospheric diffusion of exhaust gases from static firings and airborne materials emanating from inadvertent spills of fuel additives. The Lagrangian history of turbulent motions is discussed, as are both uniform and nonuniform stratification and an inversion cap. Initial calculations indicate that a significant part of the analogous atmospheric processes has been simulated by the proposed model. A plan to develop an environmental hazards handbook for the safe usage of hazardous fuels by NASA considers cold spill, hot spill and engine exhaust cases, buoyancy-source phase, vertical diffusion rates in the lower atmosphere, and receptor problems. Appendixes deal with a simple experimental system for inference of distribution at equilibrium and potential sites for NASA environmental hazards experiments. M.W.R.

N67-17639# Bolley (E.) Associates, Inc., Boulder, Colo.
BOUNDARY LAYER PROFILE MEASUREMENT SYSTEM
C. P. Edwards Boulder, Colo., Natl. Center for Atmospheric Res., Mar. 1966 11 p Prepared for Natl. Center for Atmospheric Res.
(NCAR-TN-16; PB-169875) CFSTI: HC $3.00/MF $0.65

Capabilities are surveyed for a tethered balloon system that measures vertical profiles of temperature, wind speed, wind direction, and humidity as high as 5000 feet above ground level. This airfoil balloon, available to institutions for cooperative research, is designed to maintain altitude during the winds that occur during flight. Balloon wing, telemetry package, and ground station specifications are included. M.W.R.

N67-17642# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
SIMULATION OF WIND FIELDS OVER POINT ARGUELLO, CALIFORNIA, BY WIND-TUNNEL FLOW OVER A TOPOGRAPHIC MODEL
J. E. Cermak and Jon Peterka Nov. 1966 88 p refs
(Contract N123(61756)34361A(PMR))
(CER65JEC-JAP64; AD-643689) CFSTI: HC $3.00/MF $0.65

Stably stratified flow over a 1:12,000 scale model at Point Arguello, California was studied. Mean temperature, mean velocity and mean concentration distributions obtained for the laboratory flow were compared with available field data collected at the site. These comparisons revealed that the geometrical, dynamic and thermal similarity were sufficiently achieved to give similar mean flow patterns, temperature distributions and concentration decay rates for diffusing tracers. The data revealed that a laminar laboratory flow may be used to simulate a turbulent field flow under conditions of stable thermal stratification and complex terrain. In such flow conditions, diffusion is dominated by convective dispersion. Author (TAB)

N67-17869# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
REAL-TIME METEOROLOGICAL SYSTEM FOR FIRING OF UNGUIDED ROCKETS
Louis D. Duncan and Henry Rachele Feb. 1966 26 p refs
(ECOM-5037; AD-482326)

The system was designed to provide prelaunch trajectories and impact prediction capability for unguided, high-altitude, multiple-stage rockets and to minimize errors in wind measurements due to variability in the lower altitude regions. Computers and computer software used with the impact prediction system are also discussed. Analysis of firings of two different types of rockets has shown that the system as a whole, and the meteorological system in particular, has functioned as planned. K.W.

N67-17917# American Meteorological Society, Boston, Mass.
SOME RESULTS OF RADAR SOUNDING OF THE TROPOSPHERE AND TROPOPAUSE [NEKOTORYE REZUL'TATY RADIOLOKATSIONNYKH ZONDIROVANII TROPOSFERY I TROPOPAUZY]
K. S. Zhupakhin Bedford, Mass., AFCRL, Oct. 1966 22 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 177, 1965 p 129–141
(Contract AF 19(628)-3880)
(T-R-629; TT-67-60183; AD-643558) CFSTI: HC $3.00/MF $0.65

The results of joint radiosonde and radar sounding of the troposphere and tropopause are compared. These were clear-weather soundings made in the fall of 1963. TAB

N67-17951# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
THE SCALES OF INTRA-CLOUD VARIATIONS IN METEOROLOGICAL PARAMETERS: HURRICANE CLOUDS
Bernice Ackerman 15 Oct. 1966 89 p refs
(Grants NSF G-22292; NSF GP-3881)
(TN-35)

Variance spectrum analysis was carried out on continuous measurements of temperature, liquid-water content and airspeed obtained in hurricane cloud systems, to determine whether in-cloud fluctuations were random or whether they tended to occur on some preferred horizontal scale. Results indicate that in any one cloud region the fluctuations are not random and that in addition to the cloud scale there are nonrandom components of smaller size. Considerable inter-cloud variability in the wave numbers of spectral peaks was also observed; however, in turbulent convection there was a definite tendency for two frequency domains to appear in the spectra, within which one or more modes of activity occurred. These domains were as follows: (1) 1.6 to 4.0 cy/mi with peaks most frequent around 2.5 cy/mi in the liquid-water content and airspeed spectra and more commonly at about 3.5 cy/mi in the temperature spectra; and (2) 4.5 to about 9 cy/mi with peaks around 5.5 cy/mi in liquid water and airspeed spectra, but no really preferred modal frequency in temperature. It is hypothesized that the first of the two frequency domains is thermal in origin and that the second is traceable to turbulence in the water or velocity field. Author

N67-18034*# Rand Corp., Santa Monica, Calif.
AN APPARENT STATISTICAL RELATIONSHIP BETWEEN POLAR HEAT BUDGET AND ZONAL CIRCULATION
R. E. Huschke, J. O. Fletcher, and R. R. Rapp Jan. 1967 13 p refs
(Contract NASr-21)
(NASA-CR-81689; NASr-21-(07); RM-5234-NASA) CFSTI: HC $3.00/MF $0.65 CSCL 04B

On the basis of the best available data and several reasonable assumptions, it is possible to show a 0.95 correlation between the annual cycle of the atmospheric heat loss in the Arctic and the cycle of the general circulation of the atmosphere with a lag of one month. The chief uncertainties in this potentially valuable correlation could be removed entirely or diminished significantly if satellites were used to collect pertinent data on the Arctic heat budget. Author

N67-18084*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS Quarterly Progress Report, Period Ending 31 Dec. 1966
Warren C. Kocmond and James E. Jiusto 15 Jan. 1967 15 p
(Contract NASr-156; Proj. Fog Drops)
(NASA-CR-81755; RM-1788-P-14) CFSTI: HC $3.00/MF $0.65
CSCL 04B

Sieving, centrifugal separation, and sedimentation techniques for classifying fog nuclei were examined, and of these the latter two methods show significant promise. A series of experiments to determine both drop sizes and concentration in seeded and unseeded fogs were conducted, and the measurements were related to observations of fog visibility. Results show that a typically dense fog (1000 to 1500 ft visibility as measured by a transmissometer) consists of from 300 to 450 droplets cm^{-3}. After 10 min of natural fog formation, drop sizes were found to be 2μ to 5μ diameter. These values of drop size and concentration were consistent with the measured attenuation. At another fog simulation facility, data obtained are presently being analyzed. In addition, atmospheric nuclei at subsaturated humidities (a saturated NaCl solution was used) were also investigated. Values of haze chamber humidity as a function of temperature difference between reservoirs (NaCl solution) were computed, and the results are tabulated. L.S.

N67-18106# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
THE MICROMETEOROLOGY OF THE WHITESHELL NUCLEAR RESEARCH ESTABLISHMENT AT PINAWA, MANITOBA Pre-Operational Survey Report
A. Reimer Nov. 1966 41 p refs
(AECL-2620) CFSTI: HC $3.00/MF $0.65

Data obtained from micrometeorological instruments mounted on a 200-foot triangular steel tower and a climatology ground station located in Manitoba, Canada, are analyzed. Mean annual wind speeds are found to be relatively strong, about 14.3 mph; and most frequent wind directions are found to be south–southeast and north–northwest. Under stable conditions, southerly winds are most prevalent; and northeasterly winds are the least frequent during all seasons of the year. Since the 20-foot wind was reduced by the frictional effect of the tree cover in the surrounding area, wind shear was large. Inversions usually exist at night, forming about an hour before sunset and persisting for two or three hours after sunrise. Superadiabatic conditions exist only briefly during midday. The strongest inversion recorded was 27.6°F, and average inversion during each month was 16°F. Lapse rate probability and inversion duration diagrams are included. M.W.R.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-18943# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
ROTATION GO-AROUND INSTRUMENT GUIDANCE SYSTEM
Paul A. Rauschelbach *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. 1 1966 42 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

This paper presents the accomplishments of developing an instrument system for improved rotation, climb-out, approach and go-around guidance under all weight variations, all aerodynamic configurations and all thrust levels for the C/KC-135 aircraft. The system includes a rotation/go-around (R/GA) computer, a flight director system, and a majority logic monitoring computer. During rotation, climb-out and go-around, it was determined that the primary longitudinal-axis parameter to be controlled is the angle of attack. An angle-of-attack command system was determined to yield optimum guidance during a condition of reduced thrust or engines out. The system integration and hardware development phase included the design of the total system for flight test. A flight director computer and display system are used to compute and display the signals from the R/GA computer and flight control guidance during approach. A microelectronic monitoring computer was fabricated to provide fail safe operation of the system. Author

N67-17310# Royal Aircraft Establishment, Farnborough (England).
A COMPUTER STUDY OF AUTOMATIC CONTROL ON THE I.L.S. GLIDE PATH
G. Musker and Marian Henman Feb. 1966 53 p refs
(RAE-TR-66057) CFSTI: HC $3.00/MF $0.65

A computer study is described of the effect on I.L.S. glide path performance of the addition of various damping terms to the glide path control law of a typical autopilot. The control laws used are analyzed by a number of techniques and the results achieved by the different techniques are compared. It is shown that the performance can be improved by the addition of either a vertical velocity term coupled with an acceleration term, or a vertical velocity term coupled with a pitch rate term in the control law. Author

N67-17799*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF KALMAN FILTERING TO ERROR CORRECTION OF INERTIAL NAVIGATORS
Heinz Erzberger Washington, NASA, Feb. 1967 31 p refs
(NASA-TN-D-3874) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The design and performance characteristics of an optimum error damping system for an inertial navigator are investigated. The chief component of this system is a Kalman–Bucy filter which gives best estimates of the inertial navigator's errors from noise-contaminated auxiliary velocity or position measurements. By means of digital computer simulation, the performance of the optimum error damping system was compared, whenever possible, with that of conventional methods. It was generally found that the lower the accuracy of either auxiliary measurement or initial navigator alinement, the better is the performance of the optimum system in comparison to conventional methods. The performance of an inertial system, optimally updated with auxiliary position measurements was also studied. It was found that because of the high position accuracy obtainable with these navigation aids, all errors in the inertial system, including azimuth, were strongly reduced. In view of the relatively low cost and general availability of these aids, this result is felt to be especially significant for the projected use of inexpensive inertial systems in commercial jet aircraft. Author

N67-17800*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MIDCOURSE NAVIGATION USING STATISTICAL FILTER THEORY, A MANUAL THEODOLITE, AND SYMBOLIC COMPUTER CONTROL
Jay V. Christensen and E. David Kipping Washington, NASA, Feb. 1967 45 p refs
(NASA-TN-D-3875) CFSTI: HC$3.00/MF$0.65 CSCL 17G

This report considers the application of a specific hardware-computational system to midcourse guidance and navigation of a manned spacecraft. The system consists of three major subsystems: a digital computer to process the observed data, a computer control and display panel, and a manually operated theodolite. The results have confirmed theoretical studies regarding the application of statistical filter theory midcourse guidance and navigation, and have shown that the hardware-computational system, as described, will be adequate for on-board midcourse guidance and navigation. No serious anomalies or discontinuities were detected in the statistical filter processing. The results also showed that the velocity correction parameters (thrust magnitude and direction) could be obtained with high accuracy, and, therefore, a precise vernier velocity correction system should be considered if the spacecraft is to make effective use of the system performance. The investigation demonstrated the successful use of a symbolic computer control and display panel concept. Author

N67-17835* Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
SPACE PROBE RADAR ALTIMETER STUDY. VOLUME I: TECHNICAL REPORT Final Report
Nov. 1966 168 p refs
(Contract NAS1-5953)
(NASA-CR-66262) CFSTI: HC$3.00 CSCL 17G

A discussion of the operation and performance objectives of a space probe radar altimeter and a technical discussion of various radar systems for space probe applications; are presented. Major conclusions of the study program were: (1) Pulse radar is the technique best suited for the space probe altimeter; (2) Greater weight, volume, and power consumption will exceed design goals if the system is to meet reliability and performance goals and development time is limited to conform with a 1971 launch; (3) Angular coverage required of the antenna has a significant impact on weight and volume; (4) Sterilization and decontamination requirements are not reflected appreciably in system weight, size, performance, and reliability; (5) Surface roughness data can be derived from altimeter data; (6) Principal development items incorporated in the altimeter are the antenna, TWT transmitter, and integrated microwave circuit; and (7) Requirements placed on an altimeter for future applications could be met with minor and major changes in the transmitter and antenna. S.C.W.

N67-17836* Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
SPACE PROBE RADAR ALTIMETER STUDY. VOLUME II: DEVELOPMENT PLAN Final Report
Nov. 1966 54 p refs
(Contract NAS1-5953)
(NASA-CR-66263) CFSTI: HC$3.00 CSCL 17G

Reported is a development plan which describes the program organization and schedule required to develop a radar altimeter applicable to deep space probes. Detailed are management, engineering, manufacturing, and test plans. Also included are data on cost and program funding. S.C.W.

N67-17837* Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
SPACE PROBE RADAR ALTIMETER STUDY. VOLUME III: RELIABILITY AND QUALITY ASSURANCE PLAN Final Report
Nov. 1966 50 p refs
(Contract NAS1-5953)
(NASA-CR-66264) CFSTI: HC$3.00 CSCL 17G

Reported is a reliability and quality assurance plan for the design, development, and production of a radar altimeter applicable to deep space probes. Included are data on reliability program management; system reliability engineering; parts reliability engineering; documentation; quality assurance program plan; effects of sterilization on reliability; and data on the issuance of discrepancy reports. S.C.W.

N67-17949# Wilcox Electric Co., Inc., Kansas City, Mo.
DESIGN AND DEVELOPMENT OF REMOTE MONITOR INDICATOR AND CONTROL SYSTEM FOR CATEGORY III ILS Final Report
Gul C. Asnani Aug. 1966 102 p
(Contract FA-64-WA-5215)
(FAA-RD-66-48) CSCL 17G

Circuit details are presented for various units of the Remote Monitor Indicator and Control System for Category III (all weather) Instrument Landing System (ILS) which was designed, constructed, and tested in accordance with appropriate FAA requirements. Circuit details are presented for the final design of the (1) master ILS status unit, type FA-5669X, (2) tower ILS status panel, type FA-5669X/1, (3) localizer keying monitor, type FA-5673X, (4) ILS far field delay unit (single), type FA-5674X/1 and (dual), type FA-5674X, (5) localizer transfer/control unit, type FA-5672X, (6) glide slope transfer/control unit, type FA-5670X, and the (6) glide slope antenna transfer unit, type FA-5671X. Circuit diagrams are also given. L.S.

N67-17958# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
EVALUATION OF RUNWAY CENTERLINE, HIGH-SPEED EXIT TAXIWAY AND RUNWAY-REMAINING LIGHTING SYSTEMS FOR CATEGORY III OPERATIONS Interim Report
Russell E. Gilmore Dec. 1966 59 p
(FAA-RD-66-6) CSCL 17G

Reported are results of a project designed to determine the minimum visibilities at which a pilot could remain an effective part of the aircraft control loop while using the United States standard runway and exit centerline lighting for guidance during takeoffs and rollouts; and to evaluate the effectiveness of a color-coded centerline which indicates the amount of runway remaining. An area on the runway near the exit centerline was found to cause pilot confusion in visibilities below 1000 feet. The project was expanded to include evaluation of green exit centerline lights to reduce or eliminate this confusion. A simplified low-visibility simulator, which would control the visibility from the cockpit of an aircraft, was developed for the project and used to provide simulated low visibilities. It was concluded that: (1) The United States standard runway centerline lighting configuration provides adequate takeoff and rollout guidance along the runway with visibilities as low as 200 feet; (2) The present all-white United States standard runway centerline lighting configuration presents no confusion in visibilities as low as 200 feet if exit lights are turned off or the exit centerline fixtures have green filters installed and fixtures are spaced 50 feet apart; and (3) A color-coded runway centerline lighting configuration provides runway-remaining information. It was recommended that: (1) Consideration be given to lowering takeoff

minima where centerline lighting is installed; (2) United States standard runway exit centerline lighting be developed; and (3) Consideration be given to a service test of the color-coded runway centerline. Author

N67-17959# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
OFFSET MARKER BEACON ANTENNA FOR INSTRUMENT LANDING SYSTEM IMPROVEMENT Interim Report
Robert C. Smith Nov. 1966 29 p
(FAA-RD-66-55)

An antenna array adjustable in height and azimuth aperture was tested for use in an offset marker beacon installation. Insufficient horizontal light-on pattern duration, at some offset distances, is caused by lack of power available at the antennas. The technique, however, of using offset marker antenna installations is feasible. Author

N67-18079# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
VIDICON SCAN CONVERTER AND SUPER BRIGHT RADAR DISPLAY SYSTEM Final Report
Anthony J. Myura and Philip S. Babel Jul. 1966 62 p refs
(FA-RD-66-40)

A description of the techniques employed in the development of a super bright display system for the ASR-4 is presented. Each development phase is discussed in detail with specifications defining the equipments. The investigation was undertaken to determine the feasibility of scan converting polar coordinate radar data using a vidicon technique. Author

N67-18152*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A DESIGN METHOD FOR AN OPTIMAL ATTITUDE REGULATOR FOR A SPINNING SPACE STATION
Paul S. Rempfer Washington, NASA, Feb. 1967 41 p refs
(NASA-TN-D-3854) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A study was made to show how a method in optimal control could be used in the design of a linear-feedback attitude regulator for a spinning space station. The design method is for linear systems, and the regulator, operating cyclically, minimizes a final error and uses a fixed amount of control effort in each cycle of operation. The resulting optimal feedback gains for the optimal regulator are computed and presented. The gains are time-varying and complex. For this reason a suboptimal regulator with less complex time-varying gains is designed on the basis of the optimal system. In addition, for comparison purposes, a standard constant-gain regulator is designed. Digital simulations of all three regulators are presented. It is shown that the two time-varying-gain regulators require a significantly smaller peak control torque than the constant-gain regulator. Author

N67-18155*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ANALYSIS OF SEXTANT NAVIGATION MEASUREMENTS DURING LUNAR MODULE RENDEZVOUS
T. B. Murtagh Washington, NASA, Feb. 1967 58 p refs
(NASA-TN-D-3873) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Two methods are presented for optimizing individual spacecraft–star navigation measurements along the nominal concentric flight plan rendezvous trajectory for the Apollo program. In the first method, a star is selected that will minimize the relative root-mean-square position errors at the measurement time. In the second method, a star is selected that will lie closest to the measurement plane defined by the inertial position vectors of the Command Service Module and the Lunar Module. These spacecraft–star measurements are made up to the circularization maneuver; thereafter only spacecraft-lunar horizon measurements are made. Both measurement types are processed using a Kalman filter which simultaneously solves for relative Lunar Module–Command Service Module state, inertial Command Service Module state, and the sextant bias. The results of the study indicate that fewer stars are required for the second method outlined, and that both methods produce comparable uncertainties at rendezvous. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-16762# United Kingdom Atomic Energy Authority, Dounreay (Scotland).
THE INFLUENCE OF IRRADIATION TEMPERATURE ON THE DEFECT STRUCTURES IN STAINLESS STEEL
C. Cawthorne and E. J. Fulton *In its* Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 446-460 refs (See N67-16751 07-26) HMSO: 48s

Specimens of austenitic stainless steel derived either from the cladding on experimental fuel pins or from tensile test specimens have been examined by thin foil transmission electron microscopy after irradiation in the Dounreay fast reactor to neutron doses of up to 6 x 10^{22} at temperatures between 270°C and 580°C. Black spot defects which grow into dislocation loops on annealing and finally disappear at about 700°C are produced at irradiation temperatures below ≈350°C. At irradiation temperatures between ≈350°C and 580°C spherical voids are formed which vary in size between the smallest observable and 500 Å. These voids constitute 1–2% of the volume of the material and are associated with a variety of defect types. They are almost completely annealed out at 900°C leaving a residue whose volume can be reasonably equated to the volume of helium produced by (n,α) reactions in the material. It is thought that void formation is due to the stabilization of small three-dimensional vacancy clusters by the helium produced during irradiation. Author

N67-16764# Brookhaven National Lab., Upton, N. Y.
THE FORMATION OF RADIATION DEFECT CLUSTERS IN IRON DURING POST-IRRADIATION HEATING
Joseph S. Bryner *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep 1966 p 468-479 refs (See N67-16751 07-26) HMSO: 48s

Electron-transmission microscopic studies of fast neutron irradiation damage in iron are reported. Results indicate that spots and loops which form during post-irradiation heating of relatively pure iron which was annealed and furnace-cooled before irradiation at 30 to 90°C may be due to clustering of more than one species of radiation defect. The nature of the species forming clusters visible by electron-transmission microscopy depends upon the radiation dosage and the concentration of interstitial impurities in the iron. Most of these defects appear to be unclustered in the as-irradiated condition, although some small visible clusters may form during irradiation due to thermal spikes. A suggested explanation

for the observation of larger clusters in as-irradiated iron is the precipitation of iron nitride on radiation-produced nuclei during cooling after irradiation at a temperature at which appreciable nitrogen is dissolved. Author

N67-17041# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
NEUTRON DYNAMICS AND CONTROL
David L. Herrick and Lynn E. Weaver (Ariz. Univ.) May 1966 688 p refs Proc. of the Symp. on Nucl. Eng. at the Univ. of Ariz., Tucson, 5–7 Apr. 1965; Sponsored by the Univ. of Ariz. and AEC *Its* Symp. Ser. 7
(Contract AT(11-1)-676)
(CONF-650413) CFSTI: HC $3.00/MF $0.65

Symposium papers on nonlinear system stability, optimal control, reactor dynamics, automatic control theory, space-time effects, and pulsed-reactor research are presented. For individual titles see N67-17042–N67-17072.

N67-17042# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
SOME APPLICATIONS OF MATHEMATICAL METHODS TO NUCLEAR ENGINEERING AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Elias P. Gyftopoulos *In* AEC Neutron Dyn. and Control May 1966 p 1–27 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The purpose of this paper is to discuss some applications of mathematical methods to nuclear engineering at the Massachusetts Institute of Technology (MIT). Discussed are: (a) a new criterion of asymptotic stability for nuclear reactors described by nonlinear equations including all delayed-neutron precursors; (b) a simple example illustrating the procedure for deriving stability criteria by investigating the nature of equilibrium states at infinity; (c) a novel approach to problems of non-linear optimum control for systems described by means of input–output functional relations; (d) some results on questions of space–time nuclear reactor dynamics; and (e) an application of dynamic programming to the problem of optimum refueling of a power nuclear reactor. Author

N67-17043# Michigan Univ., Ann Arbor.
A NONLINEAR STUDY OF REACTOR SYSTEMS WITH LINEAR FEEDBACK
A. Ziya Akcasu *In* AEC Neutron Dyn. and Control May 1966 p 28–37 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

Criteria are presented for local, global, and Lagrange stability, as well as a criterion for the nonexistence of solutions with a finite escape time, in reactor systems with an arbitrary linear feedback. Author

N67-17044# Brookhaven National Lab., Upton, N. Y.
EVOLUTION OF THE FINITE-ESCAPE-TIME CONCEPT IN REACTOR KINETICS
Jack Chernick *In* AEC Neutron Dyn. and Control May 1966 p 38–44 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The usefulness of the finite-escape-time concept in reactor kinetics is discussed. The general problem for a reactor with several temperature coefficients is treated. For adiabatic conditions exact criteria for the existence of solutions of finite escape time are given. It is shown that, if all temperature coefficients are positive, the solutions of the reactor-excursion problem diverge in a finite time. The method of expansion in a small parameter is explored. The quenching of a reactor excursion caused by a sudden temperature pulse is discussed. Author

N67-17045# Purdue Univ., Lafayette, Ind.
INVESTIGATIONS OF NONLINEAR STABILITY OF COUPLED NUCLEAR SYSTEMS
Stephen J. Gage, F. T. Adler, and P. N. Powers *In* AEC Neutron Dyn. and Control May 1966 p 45–76 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

An alternative model of the kinetics equations for a coupled-core reactor is derived from the fundamental transport equation. The applicability of this formulation to the analysis of nonlinear dynamic stability is discussed. An analysis of a two-core reactor in which the reactivity feedback mechanism is dependent on average core power is detailed. The behavior of the singular points for this simplified model is described for the cases when the delay times associated with coupling neutrons traveling from one core to another are neglected and when the time lags are approximately treated. Using the methods of Lur'e and Letov and of Aizerman, the authors have derived stability criteria for the two-core reactor with nonlinear power-dependent feedback. The relative advantages of the two approaches are compared. Author

N67-17046# Arizona Univ., Tucson.
STABILITY OF NONLINEAR COUPLED-CORE REACTORS
Hugh S. Murray and Donald G. Schultz *In* AEC Neutron Dyn. and Control May 1966 p 77–87 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65
The unique feature of the nonlinear equations describing the dynamics of coupled-core nuclear reactor systems is the presence of terms containing a retarded argument. A method based upon the ideas of the Russian authors Krasovskii and Razumikhin is developed for investigating the asymptotic stability of coupled-core reactors by means of the Second Method of Liapunov. Regions of stability in the state space are obtained for a simplified nonlinear model of two coupled cores. In particular, the effect of the time delay is investigated directly via the Second Method without the aid of approximations for the delayed term. Author

N67-17047# Brookhaven National Lab., Upton, N. Y.
CENTERS AND LIMIT CYCLES IN REACTOR KINETICS
Louis M. Shotkin *In* AEC Neutron Dyn. and Control May 1966 p 88–109 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

A practical method for computing the amplitude and frequency of centers and limit cycles is given. This is an extension of a method of Krylov and Bogoliubov. It considers stable periodic solutions that arise from linear solutions of the form $e^{(b \pm i\omega)t}$. Two asymptotic series are derived: one for $b/\omega = O(\mu)$, $\mu << 1$, and the other for $b/\omega = O(1)$. Analytic results are obtained with these series for two specific problems in reactor kinetics: the two-temperature problem with no prompt power coefficient and the xenon problem with no temperature feedback. Author

N67-17048# Argonne National Lab., Ill. Reactor Engineering Div.
SYNTHESIS OF AN OPTIMAL NUCLEAR REACTOR CONTROL SYSTEM
I. Kliger *In* AEC Neutron Dyn. and Control May 1966 p 110–136 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65
(Contract W-31-109-ENG-38)

The optimal control problem of a nuclear reactor is formulated to include both a large number of desired output programs and dynamic behavior by the analysis of a generalized performance index, which is a measure of the deviation of the reactor power output from its desired response. The control input, which minimizes the performance index chosen, can be realized as a closed-loop feedback system. The optimal control input is found by the calculation of the control law in terms of the instantaneous reactor state. The obtained mathematical solution turns out to be sensitive to variations of the reactor parameters or to the adjustments of the controller parameters. So that the sensitivity can be avoided, the control scheme is reduced to one that is not sensitive to the matching between the controller and the reactor parameters. The optimal solution serves as a guide to such a reduction. Because of different kinds of disturbances that exist in the reactor, the output n may be different from the expected output in an undisturbed reactor, and an auxiliary controller is added to nullify the effects of the various disturbances. Author

N67-17049# Los Alamos Scientific Lab., N. Mex.
OPTIMAL NUCLEAR-ROCKET-ENGINE CONTROL
Ronald R. Mohler *In* AEC Neutron Dyn. and Control May 1966 p 137–163 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65
(Contract W-7405-ENG-36)

The problem of controlling a nuclear rocket engine so as to minimize propellant consumption is analyzed. It is shown that the required control consists of a maximum allowable effort process. That is, reactivity and propellant flow rate must be varied so that one or both are at a maximum or a minimum allowable value while the state of the system is inside some constraint boundary in the state space. Though ostensibly a minimal-propellant-consumption process, the control is also one of minimal time. In addition to constraints in reactivity and flow rate, other necessary physical constraints (such as constraints in reactor power, rate of change of core temperature, and pump performance) are considered. The analysis is made with Pontryagin's maximum principle (along with the extensions for state-constrained problems) and physical arguments. In the analysis the system dynamics are defined by a single-lump direct-cycle heat-exchange process and a monoenergetic neutron-kinetics model. It is shown that, with a knowledge of the optimal process, conventional closed-loop control can be synthesized so that its performance nearly approximates the optimal performance, and such control can thereby be classified as suboptimal. Author

N67-17050# Arizona Univ., Tucson. Dept. of Nuclear Engineering.
SYNTHESIS OF OPTIMAL FEEDBACK CONTROL FOR NUCLEAR-ROCKET-ENGINE START-UP
Philip A. Secker and Lynn E. Weaver *In* AEC Neutron Dyn. and Control May 1966 p 164–181 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

Linear optimal feedback control theory is applied to the synthesis of an optimum nuclear-rocket-engine start-up program by use of a model-following system. This theory generates a feedback program of linear gains that alter the plant dynamics such that the rocket-engine response approaches that of the model. If small perturbations are taken about the optimum trajectories, the system differential equations become linear with time-varying coefficients. The optimum feedback control minimizes an integral quadratic performance index containing system errors and control motions. Analog-computer studies show the effect of this synthesis technique in minimizing the system error due to disturbances and the nonexact mathematical description of the system. Author

N67-17051# Rensselaer Polytechnic Inst., Troy, N. Y.
CONTROL OF ABSORPTION CROSS SECTION FOR A NUCLEAR ROCKET
C. N. Shen and T. C. Liu *In* AEC Neutron Dyn. and Control May 1966 p 182–205 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65
(Grant NsG-14-59)

Attempts are made to control the absorption cross section of the nuclear rocket with distributed-parameter kinetics. Two optimization procedures are taken, one with bang-bang control for the reference flux and precursors and the other to eliminate the jump by the maximum principle. Closed-form solutions for the control laws are obtained. Author

N67-17052# Arizona Univ., Tucson. Dept. of Electrical Engineering.
A CLOSED-LOOP, APPROXIMATELY TIME-OPTIMAL CONTROL METHOD
James L. Melsa *In* AEC Neutron Dyn. and Control May 1966 p 207–224 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65
(Grants NsG-490; NSF GP-2237)

In this paper a special class of solutions of the Hamilton–Jacobi equation called eigenvector scalar products, is used to develop a method of closed-loop, approximately time-optimal control. The method is developed first for linear systems in which the control matrix is nonsingular and then for systems in which the control matrix is singular. Finally, the extension of the method to nonlinear systems is considered. The procedure to be followed in each case is systematic and is illustrated by three examples. When a closed-loop system is designed with this method, the controller–computer must solve only algebraic equations, and hence the control can be computed continuously, in contrast to many of the present methods, which require on-line solution of two-point boundary value problems and hence discrete control. Author

N67-17053# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science.
ANALYSIS OF PULSED NEUTRON EXPERIMENTS IN MODERATING ASSEMBLIES
P. B. Daitch, R. R. Lee, and R. L. Hobson *In* AEC Neutron Dyn. and Control May 1966 p 225–244 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

Much of the analysis is based on the use of a discrete mesh or groups to represent the energy variable and the use of spherical harmonic approximations to represent the angles. Although this type of approach does not yield a continuum of eigenvalues (which is present in other analyses), it is justified on physical grounds and is sufficient to represent the situations studied. Illustrative examples of eigenvalues and eigenfunctions are presented for mass-1 free gas and beryllium over a large range of bucklings; both discrete and continuum eigenfunctions are illustrated. The major features of the real-time eigenvalues as they vary with sinusoidal and hyperbolic bucklings are shown in a schematic map of the real λ vs. B^2 plane. The analysis is then used in order to discuss some of the major areas of time-dependent thermalization investigation. Author

N67-17054# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
SPATIAL DEPENDENCE OF PULSED NEUTRON REACTIVITY MEASUREMENTS
Martin Becker and Karl S. Quisenberry *In* AEC Neutron Dyn. and Control May 1966 p 245–278 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

A series of pulsed neutron reactivity measurements is reported in which strong spatial dependence of the results is observed. The difference between prompt and delayed fundamental-mode shapes

is found to account for this dependence. The major pulsed neutron techniques are rederived by the use of a kinetics analysis in which the prompt and delayed fluxes are each assumed to be separable in space and time but in which the total flux is not. It is concluded that standard experimental methods yield a meaningful reactivity if an easily obtained spatial correction factor is applied. Author

N67-17055# North Carolina State Coll., Raleigh.
INVESTIGATION OF THE RISE PORTION OF PULSED NEUTRON CURVES
B. E. Leonard *In* AEC Neutron Dyn. and Control May 1966 p 277–298 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

Two-group theory has been applied and shows that the rise portion of the curve directly yields the Fermi age after correction for higher modes. By the Fermi age slowing-down theory, the rise portion again provides the Fermi age and other slowing-down constants, but a time correction is necessary to account for the slowing and diffusion from pulsed-source neutron energy to fission neutron energy. Corrections are discussed. Pulsed neutron methods thus hold promise of providing a measurement of Fermi age superior to the presently used indium resonance method. Also, an integrated flux method by foil activation over the core during pulsing is shown to provide a measure of the product of the fast k_{eff} factors, ϵ and p, and the fast-leakage factor. Author

N67-17056# Westinghouse Electric Corp., Pittsburgh, Pa.
MEASUREMENT OF LOCAL KINETIC PARAMETERS IN THE SAXTON REACTOR
V. Rajagopal and G. E. Swen *In* AEC Neutron Dyn. and Control May 1966 p 299–311 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65
(Contract AT(30-1)-3269)

Experimental measurements of local transfer functions were performed in the Saxton experimental power reactor, with the use of a movable in-core neutron detector, with a view to determine local kinetic parameters such as prompt power coefficient of reactivity and fuel time constant. The measurements consisted in perturbing the core reactivity through a reactivity modulator in a pseudorandom manner and measuring the response signal from an in-core detector at various locations. Input and response signals were recorded on magnetic tape and processed in a cross-power spectrum analyzer to determine the transfer functions. The experimental data were processed in a digital computer and fitted to a mathematical model in a least-square sense to yield local kinetic parameters. Applications and the usefulness of such techniques in obtaining information on local kinetic behavior of a power reactor are discussed. Author

N67-17057# Washington Univ., Seattle.
SPACE DEPENDENCE OF THE REACTOR-NOISE SPECTRAL-DENSITY FUNCTION
James R. Sheff and Robert W. Albrecht *In* AEC Neutron Dyn. and Control May 1966 p 312–322 (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The authors' recent space-dependent theory for the reactor-noise autospectral- and cross-spectral-density function is applied to a series of bare cubical reactors. The method is based upon one-energy-group diffusion theory. The spectral-density function was calculated for both critical and subcritical bare cubes of three sizes. The results are compared to the space-independent-theory prediction of the spectral density. For detector location away from the axes of symmetry and/or for subcritical systems, the comparison between the two theories is poor. For the system sizes considered, the space-independent representation is adequate for the critical case with detector located at the cube center, but it becomes less so for large systems. Although inclusion of the energy and transport effects will reduce the magnitude of the space-dependent effects, it is felt that for certain situations (i.e., larger subcritical systems with off-axes detector location) space-dependent effects should not be ignored. Author

N67-17058# Florida Univ., Gainesville. Dept. of Nuclear Engineering.
KINETIC THEORY OF SPATIAL AND SPECTRAL COUPLING OF THE REACTOR NEUTRON FIELD
Robert G. Cockrell and Rafael B. Perez *In* AEC Neutron Dyn. and Control May 1966 p 323–341 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

From the space, angle, energy, and time-dependent integro-differential form of the Boltzmann neutron-transport equation, a set of coupled, ordinary first-order differential equations is derived which describe the kinetics of the spatial and spectral coupling of the reactor neutron field. The derivation is very general and is not restricted to any particular reactor configuration or type. The coefficients in the derived expression are defined in terms of diffusion theory as well as transport theory. Existing computer codes for performing the necessary computations are discussed. The results of calculations made on an Argonaut type reactor are presented. Author

N67-17059# General Dynamics Corp., San Diego, Calif. General Atomic Div.
ADIABATIC TREATMENT OF THE XENON PROBLEM
Richard Scalettar *In* AEC Neutron Div. and Control May 1966 p 342–360 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65
(Contract AT(04-3)-167)

The coupled spatio–temporal variation of reactor neutron flux, induced by the decay and production of xenon, is investigated in the adiabatic approximation. It is shown that the slow variation of the Hamiltonian permits the approximate representation of the flux as the product of a well-determined function of the time alone and a combined function of position and time. A systematic method for the computation of higher corrections is described, and a W.K.B. description of the spatial variation permits a more detailed determination of the analytical form for the solution. Author

N67-17060# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.
LARGE REACTOR EXCURSIONS STARTING AT HIGH TEMPERATURE
Jose Canosa *In* AEC Neutron Dyn. and Control May 1966 p 361–370 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The maximum temperature reached by a reactor core in several step excursions with different Doppler reactivity feedbacks is calculated analytically with the delayed neutrons taken into account. The analytical values are compared with those obtained from a numerical solution of the point kinetics equations, and it is found that the agreement is extremely good for the more severe excursions; in these cases the difference between the respective results is less than 1%. Author

N67-17061# Argonne National Lab., Ill.
TREAT EXPERIMENTS TO PROVIDE DATA FOR FAST REACTOR SAFETY KINETICS CALCULATIONS
C. E. Dickerman and L. E. Robinson *In* AEC Neutron Dyn. and Control May 1966 p 371–385 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The Transient Reactor Test facility (TREAT) was designed for investigation of such phenomena as fuel failure thresholds, fuel motion sequences, pressure transients, coolant vaporization, and coolant movements under transient conditions. Data from experiments were used to calculate hypothetical accidents occurring in a core similar to that of the Experimental Breeder Reactor II (EBR-II); these calculations take into account variations, over the reactor core, of power and coolant flow. From photographic experiments significantly different modes of failure and failure thresholds were found for UO_2 specimens of fast reactor fuel size. Similar samples of U5, when exposed to comparable transient conditions, demonstrated resistance to mechanical damage superior to that of the uranium oxide. These differences in behavior can be explained on the basis of physical properties. Although irradiated metal fuel shows sufficient swelling under meltdown conditions to make substantial changes in the course of meltdown incidents, it is concluded that rates of swelling must be taken into account in accident conditions. Author

N67-17062# White Sands Missile Range, N. Mex. Nuclear Effects Branch.

OPERATING CHARACTERISTICS OF THE WSMR FAST BURST REACTOR

Robert L. Long *In* AEC Neutron Dyn. and Control May 1966 p 386–397 refs Submitted for Publication (See N67-17041 07-22) CFSTI: HC$3.00/MF$0.65

The White Sands Missile Range Fast Burst Reactor is an enriched uranium–molybdenum alloy assembly, unmoderated and unreflected, which provides a routine output of 5×10^{16} fissions per burst with a pulse width at half maximum power of 46 μsec. A description of the reactor stand and core designs and the results from the first two months of operation are given. Effects on the core and reactor stand of the thermomechanical shocks generated during burst operations are described. Characteristics of burst yield vs. reciprocal period, burst width vs. reciprocal period, and reciprocal period vs. reactivity are given. Author

N67-17063# General Dynamics Corp., San Diego, Calif. General Atomic Div.

CHARACTERISTICS OF LARGE REACTIVITY INSERTIONS IN A HIGH-PERFORMANCE TRIGA URANIUM–ZIRCONIUM HYDRIDE CORE

C. O. Coffer, J. B. Dee, J. R. Shoptaugh, Jr., G. B. West, and W. L. Whittemore *In* AEC Neutron Dyn. and Control May 1966 p 398–419 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF$0.65

(Contract DA-49-186-AMC-64(X))

In a continuing program to determine the operational capabilities of a TRIGA uranium–zirconium hydride core, the Advanced TRIGA Prototype Reactor (ATPR) has been safely subjected to reactivity insertions up to $4.60 (3.22% δk/k). These large reactivity insertions were made with an improved-design TRIGA fuel element clad in stainless steel. The same core has been repetitively pulsed to peak powers of 6500 Mw as well as operated at 1.5 Mw steady state. The purpose of this paper is to report and discuss the results obtained during the pulsing program in which more than 400 pulses have been made for reactivity insertions above $4.00 and up to $4.60. It has been shown by this program that it is safe and feasible to operate the reactor with reactivity insertions of the magnitude reported here. Author

N67-17064# Illinois Univ., Urbana.

FEEDBACK EFFECTS DURING SHORT-INTERVAL SERIES PULSING

G. H. Miley, H. A. Kurstedt, and G. P. Beck *In* AEC Neutron Dyn. and Control May 1966 p 420–436 refs (See N67-17041 07-22) CFSTI: HC$3.00/MF$0.65

Experimental results are reported for short-interval series pulsing with a TRIGA Mark II reactor using repetition rates from 1/2 to 3 pulses/min. The influence of repetition rate, pulse-rod drop time, and initial pulse reactivity on both the equilibrium pulse amplitude and the time to reach equilibrium is discussed. Results indicate that the reactivity coefficient associated with a water temperature increase has the opposite sign from the fuel coefficient. Some methods for optimization of series pulsing which do not involve major design modifications are noted. Also, a calculational model for rapid calculation of series pulsing is discussed. The model utilizes an integral formulation to solve directly for the time-dependent temperature. Author

N67-17065# Atomics International, Canoga Park, Calif.

REACTIVITY EFFECTS IN URANIUM–ZIRCONIUM HYDRIDE FUELED REACTOR POWER EXCURSIONS

Laurence I. Moss *In* AEC Neutron Dyn. and Control May 1966 p 437–456 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF$0.65

(Contract AT(11-1)-GEN-8)

These studies have as an objective the evaluation of the consequences of SNAP reactor excursions that might occur under postulated accident conditions. Theoretical considerations involved in establishing the prompt fuel-temperature coefficient are discussed. A simple approximation to describe reactivity-feedback effects during reactor expansion and disassembly is presented. Calculations by these approximations are compared with experimental results. The suitability of the point kinetics approximation for these reactor systems is discussed. Finally, ways in which the rather unique properties of uranium–zirconium hydride influence the behavior of the reactor with respect to energy and fission-product release during destructive excursions are noted. Author

N67-17066# Illinois Univ., Urbana.

STUDY OF THE DYNAMICS OF A TRIGA TYPE REACTOR

K. Hornyik and M. E. Wyman *In* AEC Neutron Dyn. and Control May 1966 p 457–472 refs (See N67-17041 07-22) CFSTI: HC$3.00/MF$0.65

Measurements of coolant flow and coolant temperatures were performed on a TRIGA Mark II pulsing reactor under both steady-state and transient conditions. A simple analytical model was developed and found to be in good agreement over the whole range of operations including the transients following fast insertion of reactivity in excess of $1. A nonuniform heat-source distribution over the radius of the fuel rod causing a temporary peaking of the fuel temperature near the surface of the rod during a pulse transient, as well as the natural-circulation cooling conditions, requires an adequate treatment of the heat-transfer model for the temperature feedback phenomena to be described with sufficient accuracy. Author

N67-17067# General Dynamics Corp., San Diego, Calif. General Atomic Div.

FEASIBILITY AND APPLICATION OF ACCELERATOR BOOSTER

J. M. Neill, J. R. Beyster, and J. L. Russell, Jr. *In* AEC Neutron Dyn. and Control May 1966 p 473–483 refs (See N67-17041 07-22) CFSTI: HC$3.00/MF$0.65

The concept is explored of pulsing a fast reactor by mechanical means and simultaneously pulsing it by photoneutrons from a linear electron accelerator. The resulting burst of neutrons can be thermalized to give a pulsed source with an instantaneous flux

greater than 10^{15} neutrons/cm^2/sec. The application of this pulsed thermal source to time-of-flight studies is considered. A comparison of this pulsed source with other sources is made. Author

N67-17068# Purdue Univ., Lafayette, Inc.
DYNAMIC REACTIVITY EFFECT—A FURTHER DEVELOPMENT
K. M. Campe and R. E. Bailey *In* AEC Neutron Dyn. and Control May 1966 p 484–517 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

In a recent publication a prediction has been made, based on some results obtained from simple diffusion theory, that there possibly may exist a dynamic reactivity effect in a compressible fissile medium whose geometric size is forced to change periodically. Within the assumptions inherent in the mathematical model representing the physical behavior of the system, it was found, according to diffusion theory, that, if one were able to force the rate of change of the size of the system faster than the neutron population could adjust itself to the said change, a net reactivity gain could be obtained. Supporting studies have been made by the use of the telegrapher's equation for the slab geometry and the diffusion equation for spherical and cylindrical geometries. The conditions for the dynamic reactivity effect (DRE) are presented for each geometry. Also, some additional reasoning pertaining to the physical causes of the DRE is presented. Author

N67-17069# Los Alamos Scientific Lab., N. Mex.
ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT ON-LINE PROCESS COMPUTER
Howard B. Demuth, Fred P. Schilling, and Larry Weintraub *In* AEC Neutron Dyn. and Control May 1966 p 518–530 (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The computer will be used to aid in the operation of the UHTREX reactor, the reactor coolant loops, and the coolant purification system. The computer system includes a central processor with 4000 words of magnetic-core memory, 32,000 words of drum memory, an input–output typewriter, and a paper-tape punch and reader. There are four logging typewriters and one visual-display unit. The system can sample some 600 analog and 300 digital inputs, and it can set 444 digital and 24 analog outputs. Twenty interrupt channels will be used to allow "time sharing" of input–output equipment and to initiate special programs. The computer will sample analog channels at a rate of 200 channels per second and monitor them for out-of-limit conditions, prepare logs, perform on-line calculations, keep fuel-element and other system histories, and monitor reactor-operator activities. Capability is being provided for sequencing valves in operations such as fuel loading and for controlling coolant flow rates, thermal-power output of the cooling system, etc. In addition, system diagnostic programs and emergency shutdown programs will be available. Author

N67-17070# Michigan Univ., Ann Arbor.
SOME "THEOREMS" ON NEUTRON FLUCTUATIONS AND FLUCTUATION SPECTRA
R. K. Osborn and A. Z. Akcasu *In* AEC Neutron Dyn. and Control May 1966 p 531–543 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The notion of fluctuation in critical systems is explored. The equivalence of the singlet (Langevin) and kinetic theories of fluctuation is noted. Solutions for cross-power spectral densities are presented. Author

N67-17071# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
COUPLED-CORE KINETIC BEHAVIOR
P. R. Pluta *In* AEC Neutron Dyn. and Control May 1966 p 544–565 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The scope of a system model designed to predict the transient behavior of a coupled boiling water–centrally located superheat reactor power plant is discussed. Quantitative results describing the time-dependent power changes in two coupled cores resulting from ramp reactivity insertions into each core separately are given in terms of the degree of nuclear coupling between the cores. Several of the more interesting non-nuclear features of the plant simulations are introduced. Author

N67-17072# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
PRESSURE EFFECTS ON SPACE-DEPENDENT DYNAMICS IN BOILING SYSTEMS
Amir N. Nahavandi and Richard F. Von Hollen *In* AEC Neutron Dyn. and Control May 1966 p 566–583 refs (See N67-17041 07-22) CFSTI: HC $3.00/MF $0.65

The mathematical formulation developed for this study consists of three main parts: (1) a space-dependent recirculation-loop dynamic model simulating the behavior of the heating zone, riser, steam separator, and downcomer; (2) a steam-drum lumped-parameter dynamic model; and (3) a steam-main dynamic model simulating the steam flow from the drum to the turbine steam-admission valve. A constant feedwater flow rate and the occurrence of choking flow at the turbine admission valve are among the simplifying assumptions employed. The governing space-dependent dynamic equations are solved numerically on an IBM 7094 digital computer. The mathematical analysis is applied to the dynamic analysis of a typical direct-cycle forced-circulation boiling-water reactor with the pressure regulator operative. The results indicate that the effect of system pressure variation combined with the nuclear–thermal–hydraulic interaction renders the system transient behavior more susceptible to oscillations. Author

N67-17075# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
YIELD OF CURIUM-244 IN THE SRP HIGH FLUX REACTOR
E. K. Dukes, R. L. Folger, G. A. Carothers, C. J. Banick, and M. Y. Donnan Aug. 1966 10 p refs
(Contract AT(07-2)-1)
(DP-1046) CFSTI: HC $3.00/MF $0.65

Comprehensive destructive analysis of a ^{242}Pu target slug that was irradiated to 3.7×10^{22} n/cm^2 in the Savannah River Plant high flux reactor confirmed the predicted curium yield. The measured curium yield was 0.276 g for each gram of ^{242}Pu irradiated. Curium yield was determined by counting the gross alpha activity in solutions of dissolved wafers cut from the target slug (alpha pulse height analysis verified that the alpha activity was $> > 99\%$ ^{244}Cm). The ^{243}Am (0.136 g for each gram of ^{242}Pu irradiated) and residual ^{242}Pu (0.511 g for each gram irradiated) were determined by mass spectrometry using the isotope dilution technique. Overall mass balance for the target slug was obtained to within 1%. Author (NSA)

N67-17118 Commissariat a l'Energie Atomique, Paris (France).
PLUTONIUM RECYCLING. NEUTRON STUDY ON PLUTONIUM IN THERMAL NEUTRON REACTORS [RECYCLAGE DU PLUTONIUM. ETUDE NEUTRONIQUE DU PLUTONIUM DANS LES REACTEURS A NEUTRONS THERMIQUES] Final Report
F. Regnaud, R. Bir, J. Chenouard, M. Lucas, C. Mercier et al Brussels, EURATOM, Oct. 1966 179 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-037-60-12 RDF)
(EUR-2853.f; EURAEC-1660)

A description is given of the methods applied, the preparation (fabrication processes, etc.), and the means employed, together with an account of the results obtained until 1 September 1964. The account is rounded off by a description of the theoretical studies on neutron thermalization carried out during the same period. Author

N67-17141# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
BURNUP DETERMINATION OF NUCLEAR FUELS Annual Report, 1965
M. Bresesti, ed. Brussels, EURATOM, Sep. 1966 88 p refs (EUR-3123.e) CFSTI: HC$3.00/MF$0.65

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N67-17142# European Atomic Energy Community, Ispra (Italy). Nuclear Codes Group.
CALCULATION OF NEUTRON FLUXES AND RELATED PARAMETERS
C. Mongini Tamagnini *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 11–21 refs (See N67-17141 07-22) CFSTI: HC $3.00/MF$0.65

The neutron spectra and related parameters T, r, β, and R were calculated for the UC specimens to be irradiated in the DIRCE loop of the Ispra I reactor using nuclear codes. The ratio $\bar{\phi}/\phi$ s, between the average flux in the fuel and the surface flux, was also calculated, this value being necessary in the burnup determination starting from neutron flux measurements on the irradiated fuel. R.N.A.

N67-17148# European Atomic Energy Community, Ispra (Italy). Nuclear Chemistry Lab.
FISSION PRODUCT DETERMINATION BY GAMMA SPECTROSCOPY
A. M. Bresesti, M. Bresesti, F. Cappellani, G. Magni, and G. Restelli *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 41–59 refs (See N67-17141 07-22) CFSTI: HC$3.00/MF$0.65

Observations obtained in the analysis of fission product mixtures by gamma spectrometry with NaI(T1) and germanium lithium-drifted detectors are presented along with the results obtained in the burnup determination of irradiated UC samples. The activities of the fission products Cs^{137}, Ce^{144}, and Ru^{106} were measured in irradiated UC samples. Due to the strong difference in the fission yields of Ru^{106} for U^{235} and Pu^{239} fission it was possible to determine, by comparison of the Cs^{137}, Ce^{144}, and Re^{106} activities, the separate contributions of the U^{235} and Pu^{239} to the total number of fissions. R.N.A.

N67-17150# European Atomic Energy Community, Ispra (Italy). Nuclear Chemistry Lab.
DETERMINATION OF Pu^{239}+Pu^{240} ACTIVITY BY α SPECTROMETRY
M. Bresesti, F. Capreliani, G. Magni, G. Restelli *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 62–65 refs (See N67-17141 07-22) CFSTI: HC$3.00/MF$0.65

Preliminary experiments for the determination of the Pu^{239}+Pu^{240} activity were made using a method based on isotopic dilution with Pu^{238} and alpha spectrometry with semiconductor detectors. The method requires, after the addition of Pu^{238}, a purification of the plutonium mixtures from uranium, americium, and fission products. The source for the alpha spectrometry is prepared by electrodeposition. The energy and intensity of the main alphas of Pu^{238}, Pu^{239}, Pu^{240} are tabulated. An alpha spectrum obtained by semiconductor detectors of the mixture of Pu^{238}+Pu^{239}+Pu^{240} separated from irradiated uranium carbide, is shown. In the experiments performed, plutonium amounts of a few micrograms were separated from uranium carbide amounts of a few milligrams. R.N.A.

N67-17151# European Atomic Energy Community, Ispra (Italy). Nuclear Chemistry Lab.
NEUTRON FLUX MEASUREMENTS AT THE SURFACE OF UC SPECIMENS
A. M. Bresesti, M. Bresesti, and H. Neumann *In its* Burnup Determination of Nucl. Fuels Sep. 1966 p 66–76 refs (See N67-17141 07-22) CFSTI: HC$3.00/MF$0.65

Very dilute alloys of cobalt (1% and 0.1%) and silver (0.1%) in aluminum were developed for neutron flux measurements. Using the cobalt–silver pair, the thermal flux and the $r\sqrt{T}/To$ factor were determined. In this connection, a new determination of the s_0 factor for Ag^{109} was made yielding 18.23±0.36. R.N.A.

N67-17154# Naval Radiological Defense Lab., San Francisco, Calif.
RADIONUCLIDE RELEASE FROM AERO-SPACE NUCLEAR REACTOR FULES. V: PHASE TWO: PULSED NEUTRON IRRADIATION OF FUEL IN WATER
Leo W. Weisbecker, Ming G. Lai, Harry A. Goya, and Herman I. Cordova 22 Sep. 1966 70 p refs
(Contract AT(49-5)-2084)
(USNRDL-TR-1046; AD-640622) CFSTI: HC$3.00/MF$0.65

Accidental seawater immersion of a NERVA/ROVER type core would result in a criticality excursion, releasing fission product radionuclides to the environment. In order to simulate the excursion situation and to study the resulting radionuclide release, specimens of NERVA/ROVER fuel were irradiated under different pulsed neutron conditions in a TRIGA Mark F reactor, the KEWB reactor, and the KIWI-TNT reactor excursion test. Most of these specimens were irradiated immersed in water. Under these conditions

measurements are made of (1) the fission product inventories of fuel specimen and environmental water (2) internal capsule pressure generated, (3) fuel body and microstructure damage, and (4) leaching properties of irradiated fuel. Irradiation effects of greater than moderate significance occurred only in the fuel specimen irradiated most severely in the KIWI-TNT reactor excursion test. Release of fission products to the water appeared to be a function of exposed surface area of the fuel and was less dependent on specimen specific fissioning for both long term leaching after irradiation and during irradiation. Fission product fractionation in the fuel was a function of the specimen specific fissioning. All fission products which fractionated, except I131, have a volatile precursor. Author (TAB)

N67-17181*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

GAMMA AND NEUTRON DOSE MEASUREMENTS FOR A THERMAL TUNGSTEN NUCLEAR ROCKET CRITICAL EXPERIMENT

G. Houghton, C. Jupiter, and G. Trimble [1966] 45 p refs
(Contract SNPC-27)
(NASA-CR-72081; GA-6942) CFSTI: HC $3.00/MF $0.65 CSCL 21F

This report describes the measurement of the gamma and neutron dose distributions in Core III of the Thermal Tungsten Nuclear Rocket Critical Experiment. The reactor core consisted of a cylindrical array of fuel elements and poison tubes in a water filled tank. A top view of the core illustrates the twelve-fold symmetry of the core assembly. Radial and axial dose distributions in the core were measured by inserting specially constructed thimble ionization chambers in the hollow spine of the fuel elements and in the poison tubes. The dosimeters were of two types; one sensitive mainly to energy deposition from gamma rays and fast neutrons. The absolute gamma sensitivity of the ionization chambers was determined using an X-ray machine, Co^{60} radiation and 7 MeV electron bremsstrahlung. The radiative energy deposition in the neutron dosimeters was determined by comparing the dosimeter response with that of a water calorimeter in a TRIGA Mark I reactor. A time history of the gamma intensity in the critical assembly core was also measured, showing the contribution of delayed gamma to the total gamma radiation. Author

N67-17348# Centro Informazioni Studi Esperienze, Milan (Italy).

HEAT TRANSFER CRISIS WITH STEAM-WATER MIXTURES IN COMPLEX GEOMETRIES: EXPERIMENTAL DATA IN ANNULI AND CLUSTERS

N. Adorni, G. P. Gaspari, G. Germani, G. Peterlongo, R. Ravetta et al. Brussels, EURATOM, Nov. 1966 57 p refs
(Contracts EURATOM-060-61-7 RDI; EURATOM-056-62-1 RDI)
(EUR-2334.e; EURAEC-1359) CFSTI: HC $3.00/MF $0.65

All the heat transfer crisis and pressure drop data for upward flow of steam-water mixtures in test elements having a complex geometry (annuli:360 points; clusters:280 points) obtained under CAN-2 and CAN-3 programs are presented. Tests were performed both without spacers, and with different spacer arrangements. This report gives only a short description of results; as the only exception the influence of spacer arrangement is discussed. Author

N67-17351#

THE USE OF SEALED RADIOISOTOPES IN INDUSTRY (KEY STUDIES 5 TO 8) [DIE ANWENDUNG GESCHLOSSENER RADIOISOTOPE IN DER INDUSTRIE (FALLSTUDIEN 5 BIS 8)]

H. Wieczorek and H. Erhardt Brussels, EURATOM, Oct. 1966 34 p In GERMAN; ENGLISH summary
(Contract EURATOM-018-62-12 IRAD)
(EUR-2776.d) CFSTI: HC $3.00/MF $0.65

Key studies Nos. V to VIII examine typical instances of the use of sealed radioactive isotopes in industrial measuring methods. *Key study No. V* deals with the measurement of the charge height in a cupola furnace and the application of nuclear level gauging devices in automatic charging. The use of the isotope-regulated charging hoist has the effect of increasing a cupola furnace's productivity in terms of man-power and making the smelting operation a smoother process. By saving labour, the costs of the isotope hoist is recovered in about 3 months' time. *Key study No. VI* covers the use of isotopes to measure the filling height in pressure tanks in which chemical syntheses are carried out. In the case investigated, the nuclear method was the only possible way of measuring the level in the pressure vessel and thus, beside the real level gauging, making it possible to distinguish the various phases of the medium and the occurrence of foam. *Key studies Nos. VII and VIII* concern the use of radioactive isotopes in measuring filling level and density in the production of aluminium oxide from bauxite according to the Bayer process. Owing to the heavy incrustations that occur in the tanks, the conventional instruments cannot be employed. In this process the continuity of the whole system depends essentially on the use of such nuclear equipment. Its introduction offers the best solution of the level gauging, density measurement as well as the control problems present in this process. Author

N67-17352# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).

RARE GAS DIFFUSION IN SOLIDS [DIFFUSION VON EDELGASEN IN FESTKOERPERN] Annual Report, 1965

D. Beer, A. Brenner, F. Felix, W. Miekeley, H. Migge et al Brussels, EURATOM, Oct. 1966 34 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-028-64-1 TEED)
(EUR-2848.d; EURAEC-1650) CFSTI: HC $3.00/MF $0.65

Results are presented of PAD-measurements of the systems UO_2 UC and ThO_2/Xe, UO_2/Kr, CaF_2/Ar, Kr, Xe, CaO/Ar, KF, KCl, KBr and KI/Ar and AgLi/T. After references to detailed individual descriptions of the systems and a review of the measurement method used, a comparison is made of the temperature-dependence of inert gas release by volume diffusion in these systems. The observed deviations from the ideal diffusion kinetics caused by evaporation of the sample and the influence of gas-traps are discussed in detail on the basis of sample experiments. A review of the literature on diffusion measurements on UO_2 and UC is appended. Author

N67-17353# Central Technical Inst., TNO, The Hague (Netherlands).

RESEARCH ON THE INFLUENCE OF CONDITIONS OF FLOW, SUBCOOLING AND COMPOSITION OF THE BURNOUT HEAT FLUX OF POLYPHENYL REACTOR COOLING AGENTS

D. A. van Meel and M. L. G. van Gasselt Brussels, EURATOM, Sep. 1966 51 p refs
(Contract EURATOM-166-64-8 ORGN)
(EUR-3120.e) CFSTI: HC $3.00/MF $0.65

Research carried out on forced convection non-boiling, subcooled boiling- and sub-cooled burn-out heat transfer and pressure drop of terphenyl mixtures in vertical test sections is summarized. Recommended correlations are presented for heat transfer and pressure drop, for upflow through the round 5 mm vertical tube, 500 mm in length. Author

N67-17355# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.

EXPERIMENTAL INVESTIGATION OF THE U^{238} RESONANCE NEUTRON CAPTURE INTEGRAL OF URANIUM CARBIDE CLUSTERED FUEL ELEMENTS CONTAINING MODERATING COOLANTS

A. Boeuf and S. Tassan Brussels, EURATOM, Oct. 1966 83 p refs

(EUR-3152.e) CFSTI: HC$3.00/MF$0.65

An extensive experimental study of the effective resonance integral for U^{238} capture of U and UC elements with several geometries was undertaken. This report describes the last phase of this investigation, i.e., the measurement of the U^{238} effective resonance integral of 4-rod and 7-rod uranium carbide (UC) clustered fuel elements, of varying geometry and containing several cooling media at room temperature. The paper also provides detailed information on the experimental techniques used. Author

N67-17356 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

FUEL-CLAD CONTACT CONDUCTANCE

J. Arrighi, C. Mustacchi, and S. Zanella Brussels, EURATOM, Oct. 1966 119 p refs

(EUR-3155.e) CFSTI: $3.00

An investigation was made of clad-pellet contact conductance for reactor fuel elements. Standard plane geometry correlations were shown to be unreliable whereas suitable cylindrical geometry measurements both in- and out-of-pile were accounted for by theoretical and experimental analysis. Both the gas conduction and the metal-to-metal conduction components were studied using as parameters the elastic and plastic properties of the materials in contact, contact pressure, surface finish and nature of the fluid in the gap. Particular care was given to the case of uranium monocarbide and sintered aluminum powder as pellet and clad. Author

N67-17402# Oak Ridge National Lab., Tenn.

THE OAK RIDGE HIGH FLUX ISOTOPE REACTOR, DESIGN AND INITIAL OPERATION

T. E. Cole [1966] 32 p refs Presented at the Sem. on Intense Neutron Sources, Santa Fe, N. Mex.

(Contract W-7405-ENG-26)

(ORNL-P-2491; CONF-660925-1) CFSTI: HC$3.00/MF$0.65

A summary description is presented of the general features of the HFIR facility. The startup program, development, construction, and operating costs, experimental program plans, and possibilities for achieving a higher neutron flux are discussed. NSA

N67-17404# Oak Ridge National Lab., Tenn.

HEATING IN INFINITE CYLINDERS BY UNIFORM GAMMA SOURCES

C. W. Nestor, Jr. and H. C. Claiborne 15 Aug. 1966 33 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1260) CFSTI: HC$3.00/MF$0.65

As an aid to the reactor designer concerned with gamma heating in elements that may be approximated by long cylinders, the point kernel describing the transfer of gamma energy for the case of sources distributed uniformly throughout a right circular cylinder of infinite length is integrated. Since the coefficients were available for a third-degree polynomial representation of the energy absorption buildup factor for several materials, this representation was chosen and the solution was reduced to a single numerical integration for each term in the buildup factor expansion. In addition, an analytical expression for the contribution from the linear term in the expansion was obtained. The reduction of the solution to a single integration, the derivation of the analytical expression for the linear term contribution, and the numerical integration procedure are described. The results of the calculations are given in tabular and graphical form, and listings of the Fortran-63 programs are included for reference. Author (NSA)

N67-17408# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

POSSIBLE OPTIMUM USE OF THORIUM AND URANIUM EMPLOYING CROSSED-PROGENY FUEL CYCLES

E. A. Eschbach and D. E. Deonigi May 1966 26 p ref Presented at the 2d Intern. Thorium Fuel Cycle Symp., Gatlinburg, Tenn., 3–6 May 1966

(Contract AT(45-1)-1830)

(BNWL-289; CONF-660524-14) CFSTI: HC$3.00/MF$0.65

A study was made of the various ways of combining the advantages of Th and U fuel cycles so that Th could be more economically used in thermal reactors. The following conclusions are made: The crossed-progeny fuel cycles can be competitive with slightly enriched U fuel cycles; crossed-progeny fuel cycles would upgrade present LWR performance, making it a true advanced converter; heavy water reactors fueled with Pu–Th could economically supply the ^{233}U for the cycles; Pu–Th fuel would not contaminate the new ^{233}U with ^{235}U and ^{236}U; the high enrichment required by Th fuels could be decreased by reducing the Th density; and very high specific power and reductions in reactivity swing could be obtained by using Th, ^{238}U, and Pu as a ternary fuel. NSA

N67-17410# Aktiebolaget Atomenergi, Stockholm (Sweden).

NEUTRON SCATTERING AND THERMALIZATION LECTURES

S. N. Purohit May 1965 160 p refs Lectures Presented at Stockholm, 1963

(S-333; NP-16291)

Four lectures on selected topics of neutron scattering are presented. They discuss (1) scattering law formalism, (2) incoherent scattering laws and width functions, (3) Zemach-Glauber treatment for molecules, and (4) scattering laws for liquid moderators (H_2O and D_2O). In addition, five lectures dealing with topics of present interest in neutron thermalization studies with a special emphasis on the applications of the matrix elements of the scattering operator are included. NSA

N67-17423# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

SUPERCRITICAL TECHNOLOGY PROGRAM Third Quarterly Progress Report, Oct.–Dec. 1966

J. F. Patterson and W. S. Boyd, ed. Dec. 1966 95 p refs

(Contract AT(30-1)-3374)

(WCAP-3374-4) CFSTI: HC$3.00/MF$0.65

Activities in a program to build and install a supercritical water-cooled, in-pile fuel testing loop, and test fuel in a pressure tube to demonstrate the feasibility of collapsed clad elements in a reactor environment, cooled by supercritical water, are reported. Work toward evaluation of the design of the fuel elements by post-irradiation examination and evaluation of loop performance by analyzing operating data are also reported. Two fuel assemblies manufactured by different methods (pellets and vibratory compaction) will be tested. Two clad materials (16 Cr–20 Ni SS and Incoloy 800) will be included in each assembly. An existing loop design and a large number of loop components previously purchased by Westinghouse were turned over to the AEC under the terms of the contract. The design of the loop is complete and the remainder

of the components are being purchased under the contract. Fuel assembly and pressure tube designs were completed. The pressure tube and fuel assemblies are being fabricated. Author (NSA)

N67-17430# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.

THE TEST ANALYSIS OF A DEVICE FOR THE HYDROGENATION REGENERATION OF DECOMPOSED GAS–OIL COOLANT IN AES "ARBUS" [ANALIZ ISPYTANI USTANOVKI DESTRUKTIVNO-GIDROGENIZATSIONNOI REGENERATSII GAZOILEVOGO TEPLONOSITELYA AES "ARBUS"]

Yu. N. Aleksenko, A. M. Brodskii, A. I. Zabelin, V. P. Kovrolev, K. P. Lavrovskii et al 1966 24 p In RUSSIAN
(IAE-1066)

The results of the experimental operation of the regeneration unit of the Atomic Electrical Station "Arbus-I" and of numerous laboratory investigations are presented. It was found that the hydrogenation regeneration of decomposed organic coolants reduces substantially the radiolytic losses of carriers. The optimal temperature in the reaction devices was found to be 360°C, hydrogen pressure – 40 to 50 atm, volumetric rate of regenerated product –0.3 to 0.5/hour, and the molar ratio of hydrogen and the regenerated product – 6:1. Numerous other recommendations are also given. NSA

N67-17435# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

REPROCESSING OF IRRADIATED FUEL Special Report No. 6

W. Goossens [1966] 43 p
(Contract EURATOM-006-65-7 RCIB (RD))
(EURAEC-1659; EUR-2852; R-2376) CFSTI: HC$3.00/MF$0.65

The problems connected with the chemical decladding and gaseous reprocessing of heterogeneous fuel were investigated. It is possible in practice to effect the chemical decladding of elements canned in Zircaloy by means of HCl at 400°C. It is also possible to declad elements canned in stainless steel by means of 40% HCl in O_2 at 550°C, but many technical problems are involved. The gaseous reprocessing methods with a selective fluorination of uranium (BrF_5 or ClF_3 procedure) offer possibilities of industrial application with respect to their uranium part. The plutonium part of none of the known gaseous reprocessing methods holds out any prospect of industrial application at present. The conditions of plutonium subtilization are therefore being more closely investigated. An account is given of the difficulties encountered, together with a description of some technical realizations in different laboratories that were visited. Author (NSA)

N67-17438# Aerojet-General Nucleonics, San Ramon, Calif.

RADIOISOTOPE APPLICATIONS IN HYDROSPACE. VOLUME III: FUEL SPECIFICATION Final Report

Feb. 1966 52 p refs
(Contract AT(40-3)-368)
(AGN-8163, Vol. III) CFSTI: HC$3.00/MF$0.65

The use of cobalt-60 as a heat source for a small undersea craft, the Radio Isotope Submersible Engine (RISE) is described. Preliminary fuel specifications for the conceptual design of the heat source are reported. The specific activity will be 200 C/g with total activity of 1.59 MC. The outer container will be Hastelloy C with an overall diameter of 0.866 in. and an overall length of 5.640 in. The maximum fuel temperature is <1500°F. NSA

N67-17444# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

COMPARATIVE COSTS OF OXIDE FUEL ELEMENTS. VOLUME I: THE COMPUTED COSTS OF FUEL ELEMENTS (VIBRATIONAL COMPACTED OR PELLET) ENRICHED WITH U^{235} OR LOW EXPOSURE PLUTONIUM OR HIGH EXPOSURE PLUTONIUM

J. B. Brunham, L. G. Merker, and D. E. Deonigi Jul. 1966 107 p
(Contract AT(45-1)-1830)
(BNWL-273, Vol. 1) CFSTI: HC$3.00/MF$0.65

Computed fuel fabrication costs are given for both vibrational-compaction and palleting fuel plants which would individually fabricate 1 ton per day of a reference oxide fuel element enriched with ^{235}U or low-exposure (1000 Mwd/mt) or high-exposure (24,000 Mwd/mt) Pu. The operation of both types of fuel plants and the computational model are described, and the results are compared with earlier studies. A computer printout from the Fuel Element Fabrication Code is included as an appendix. NSA

N67-17445# Argonne National Lab., Ill. Chemical Engineering Div.

COMPARATIVE COST STUDY OF THE PROCESSING OF OXIDE, CARBIDE, AND METAL FAST-BREEDER-REACTOR FUELS BY AQUEOUS, VOLATILITY, AND PYROCHEMICAL METHODS

M. Levenson, V. G. Trice, Jr., and W. J. Mecham May 1966 168 p refs
(Contract W-31-109-ENG-38)
(ANL-7137) CFSTI: HC$3.00/MF$0.65

A study was made to determine the relative economic potential of the various fuel-reprocessing technologies as applied to several possible fast-reactor fuels. For each of three alternative fuel types, namely, uranium oxide–plutonium oxide, carbide, and metal, flowsheets and plant designs were specific and capital and operating costs were estimated for three alternative types of processes: aqueous solvent extraction, fluid-bed volatility, and pyrochemical. The conceptual plant components for which the costs were estimated were the processing plant, ultimate waste disposal, analytical laboratories, auxiliary facilities, out-of-reactor fuel inventory, and shipping of the spent fuel. For each of these cost centers, three sizes of processing plant were considered: an on-site plant serving one 1000-Mw(e) fast reactor; an on-site plant serving three 1000-Mw(e) reactors; and a central processing plant serving ten 1000-Mw(e) reactors. Data are tabulated. NSA

N67-17454# Battelle-Northwest, Richland, Wash. Radiological Sciences Section.

THE REDUCTION OF REACTOR EFFLUENT WATER RADIONUCLIDES BY THE ADDITION OF SODIUM SILICATE TO PROCESS WATER: 105 D HALF PLANT ADDITION

D. E. Robertson Aug. 1966 14 p refs
(Contract AT(45-1)-1830)
(BNWL-282) CFSTI: HC$3.00/MF$0.65

Research and development on the reduction of radionuclides discharged to the Columbia River in reactor effluent is described. Sodium silicate as SiO_2, was added to the process water supplying 1/2 of the D Reactor at an average concentration of 15 ppM, which gradually reduced the radionuclide concentration entering the Columbia River. After the 8th month an equilibrium condition was reached, and the levels of ^{76}As, ^{51}Cr, ^{239}Np, ^{32}P, ^{124}Sb, and ^{64}Cu were lowered by factors of about 9.0, 7.0, 6.0, 3.0, 3.0 to 5.0 and 1.5 respectively. Concentration of ^{65}Zn remained unchanged. The only significant increases were due to ^{24}Na, and trace amounts of ^{140}La and other rare earth elements. Cobalt-60 and ^{46}Sc

behaved erratically. The studies suggest that if sodium silicate were used on a full scale (5 reactor basis), river concentration of radionuclides could be proportionally reduced. NSA

N67-17457# Oak Ridge National Lab., Tenn.
ADDENDUM: INFLUENCE OF CROSS-SECTIONAL SHAPE ON IRRADIATION-INDUCED STRESSES IN GRAPHITE COLUMNS
F. J. Witt and B. L. Greenstreet Aug. 1966 18 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1574) CFSTI: HC $3.00/MF $0.65

A supplement is presented for an earlier paper published in Nuclear Science and Engineering entitled "Influence of Cross-Sectional Shape on Irradiation-Induced Stresses in Graphite Columns." In particular the results from the study of noncircular geometrical shapes are discussed with reference to the complete stress plots for the various configurations. These plots were not in full in the original paper. Author (NSA)

N67-17464# Battelle-Northwest, Richland, Wash.
HIGH TEMPERATURE RADIATION DAMAGE TO GRAPHITE. PART II: RADIATION DAMAGE IN GRAPHITE, 1 APRIL 1960–1 JUNE 1965
J. T. Meers, J. F. Doar, and H. H. Yoshikawa May 1966 62 p refs Prepared jointly with Union Carbide Corp.
(Contracts AT(45-1)-1603; AT(45-1)-1830)
(BNWL-237) CFSTI: HC $3.00/MF $0.65

All of the post irradiation test data through June 1, 1965, for the samples described in Part I of this report are tabulated by sample set. From this mass of data, selected cases of interest have been chosen for discussion of each of the properties which were measured. Lengths and coefficients of thermal expansion were determined by Battelle-Northwest Laboratory; the remainder of the properties discussed were measured by the Research Laboratory staff of the Carbon Products Division of Union Carbide Corporation. Author (NSA)

N67-17470# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
INFLUENCE OF THERMAL RATING AND BULK DENSITY ON IRRADIATION PERFORMANCE OF FUSED UO_2 TUBULAR FUEL ELEMENTS
G. Rolland Cole Aug. 1966 24 p refs
(Contract AT(07-2)-1)
(DP-1060) CFSTI: HC $3.00/MF $0.65

Mechanically compacted tubes of fused and ground UO_2 in Zircaloy sheaths, with bulk densities between 82 and 90% of theoretical, were irradiated in the heavy water components test reactor to 3500 MWd/Te_u at thermal ratings up to 50 Watts/cm. Fission gas release up to 60% and extensive columnar grain growth occurred in elements operating at thermal ratings of approximately 40 to 50 Watts/cm. Gas release was not significantly affected by bulk density. The tubes of lower density, 82 to 87%, that operated at the higher thermal ratings experienced substantial decreases in core volume and formed a lengthwise ridge in the outer sheath. Author (NSA)

N67-17472# Atomic Energy Commission, Washington, D. C. Div. of Reactor Development and Technology.
SUMMARIES OF FUELS AND MATERIALS DEVELOPMENT PROGRAMS
William L. B. Rice, ed. Mar. 1966 213 p refs
(TID-6506, Pt. 1) CFSTI: HC $3.00/MF $0.65

Descriptions are given of the research and development programs directed by the Fuels and Materials Branch of the Division of Reactor Development and Technology. The contractors are listed alphabetically, and a subject index is included. NSA

N67-17477# Phillips Petroleum Co., Idaho Falls, Idaho.
SEFOR β/I MEASUREMENTS BY NOISE ANALYSIS TECHNIQUES
R. P. Morrell Aug. 1966 50 p
(Contract AT(10-1)-205)
(IDO-17210) CFSTI: HC $3.00/MF $0.65

Cross-power spectrum techniques as applied to β/I measurements on the ZPR-III mockup of the SEFOR core are evaluated. Methods used to obtain the auto-power spectra and cross-power spectrum of two signals contaminated with noise are reviewed. Summaries are presented of the problems of obtaining a reactor cross-power spectrum using two detectors, of the frequency response determination of the chambers and the associated amplifiers and tape recording equipment, and of the results of the measurement and evaluation of B/I in the SEFOR ZPR-III. NSA

N67-17485# Thermo Electron Engineering Corp., Waltham, Mass.
VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS Quarterly Progress Report, May–Jul. 1966
J. B. Dunlay, M. L. Pequin, V. L. Poirier, and L. van Someren 30 Aug. 1966 51 p
(Contract AT(30-1)-3634)
(ALO-3634-2; QPR-2) CFSTI: HC $3.00/MF $0.65

Both the compatibility screening and planar thermal conductivity test assemblies were completed and tests were initiated. Results of the 100 hour and 500 hour compatibility tests are presented. Heat loss measurements through a 40 layer Ta–Y_2O_3 insulation sample are described. A heat flux of 0.55 watts/cm^2 was obtained for the 1700°C hot side temperature. Analytical techniques of correlating the experimental data are discussed. Preliminary designs are shown for the support insulation heat loss and soak test assemblies which will be fabricated during the next quarter. Author (NSA)

N67-17493# Southwest Research Inst., San Antonio, Tex.
INVESTIGATION OF THE FABRICATION AND INSTALLATION OF THE LACBWR REACTOR PIPING SYSTEM
Paul D. Watson 12 Aug. 1966 37 p refs
(Contract AT(11-1)-1228)
(SwRI-1228-7-34) CFSTI: HC $3.00/MF $0.65

Reviews of component specifications and design are presented along with results of inspections for contractor compliance. It is concluded that the LACBWR piping system and its components were fabricated and installed in a satisfactory manner and that all applicable specifications and code requirements were met. NSA

N67-17494# Oak Ridge National Lab., Tenn.
IN-PLACE IODINE FILTER TESTING
J. H. Swenks [1966] 14 p refs Presented at the 9th Air Cleaning Conf., Boston
(Contract W-7405-ENG-26)
(ORNL-P-2411; CONF-660904-11) CFSTI: HC $3.00/MF $0.65

A series of in-place iodine filter tests was performed on the charcoal iodine filters at the High Flux Isotope Reactor. Two sets of charcoal filters were tested, the first for elemental iodine retention; and the second for methyl iodide and elemental iodine

retention. Test results are presented, and conclusions drawn from those results are discussed. Author (NSA)

N67-17497# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
COMPARATIVE COSTS OF OXIDE FUEL ELEMENTS. VOLUME 3: THE EFFECT ON FUEL ELEMENT COSTS WHEN CERTAIN REFERENCE VALUES ARE VARIED
J. B. Burnham, D. E. Deonigi, and L. G. Merker Aug. 1966 19 p ref
(Contract AT(45-1)-1830)
(BNWL-273, Vol. 3) CFSTI: HC $3.00/MF $0.65

The costs of fabricating a reference oxide fuel element by the vibrational compaction and sintered pellet processes incorporating three modes of enrichment (UO_2, low exposure PuO_2, and high exposure PuO_2) are examined. The effects of varying throughput, high exposure Pu shielding, Zircaloy cost, U and Pu costs, use charge rate, and working capital rate on fuel element costs are investigated. NSA

N67-17498# Atomics International, Canoga Park, Calif.
DRUTES: A CODE TO CALCULATE THE DESIGN POINTS OF AN UNMANNED, DIRECT-RADIATING, THERMOELECTRIC SYSTEM. (NAA PROGRAM DESCRIPTION)
E. L. Bramblett and J. H. Van Osdol 20 Apr. 1966 86 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11819) CFSTI: HC $3.00/MF $0.65

DRUTES provides a rapid means of determining system weights, sizes and performance information for unmanned nuclear thermoelectric power systems, which utilize the SNAP-8 and 10B reactors and direct radiating SiGe thermoelectric converters. In addition, methods are provided for optimizing systems for a given electrical power level to yield minimum system weight. The components included in the calculations are the reactor-reflector assembly, gamma and neutron shields, converter-radiator, support structure, NaK piping, and dc conduction pumps and buses. Author (NSA)

N67-17520*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
REPORT ON THE DESIGN REQUIREMENTS FOR REACTOR POWER SYSTEMS FOR MANNED EARTH ORBITAL APPLICATIONS Final Report
Jan. 1967 254 p
(Contract NAS1-5547)
(NASA-CR-66254; DAC-57950) CFSTI: HC $3.00/MF $0.65
CSCL 18N

Results of an assessment of the design requirements for reactor power systems for manned Earth orbital applications are presented. The purpose of the study was to determine those reactor power system concepts that could meet effectively the constantly increasing power demands for Orbital Research Laboratory (ORL) missions and beyond, and satisfy a postulated 1974 to 1977 launch date. Integration of reactor power systems with a manned Earth-orbital space station, using the Manned Orbital Research Laboratory (MORL) concept as an example, has resulted in definition of ORL reactor power system combinations useful at 10-, 20-, and 30-kWe power levels, and the pertinent conclusions and recommendations on design of both the reactor power systems and the overall mission and space vehicles. Study objectives were satisfied by a systematic design analysis and integration of five basic reactor-power conversion concepts, including the SNAP-8-type reactor in combination with the SNAP-8 and SNAP-2 mercury Rankine, Brayton, and the direct radiating and compact converter thermoelectric systems. It is concluded that all of the reactor power systems investigated can be effectively integrated with the MORL to satisfy all laboratory functions and mission objectives, and to provide potential for increased capability and growth accommodation in the laboratory. S.C.W.

N67-17522# Oak Ridge National Lab., Tenn.
CORE DESIGN AND CONTAINMENT COST STUDY FOR GAS-COOLED FAST REACTOR STUDIES
R. E. Hoskins Sep. 1966 127 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1194) CFSTI: HC $3.00/MF $0.65

Some of the supporting analytical work performed at Oak Ridge National Laboratory to develop concepts of gas-cooled fast breeder reactors is presented. Heat transfer calculations are given for the various core configurations considered, and these configurations are compared on the basis of specific power and pumping power requirements. Some alternate fuel designs are discussed, one of which is the concept of coolant circulating inside tubes that are surrounded by fuel. Thermal bowing and flow-induced vibrations in fuel pins are analyzed. Optimization studies of secondary containment are also included. Author (NSA)

N67-17523# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
CONNECTICUT YANKEE SET POINT STUDY
M. A. Mangan Jun. 1966 127 p
(Contract AT(30-1)-3250)
(NYO-3250-7; WCAP-2948) CFSTI: HC $3.00/MF $0.65

Work that formed the basis for the definition of a consistent set of control system set points to be used during initial plant tests and operation of the Connecticut Yankee plant is described. These set points are based on maintaining adequate control system performance over the whole range of predicted plant operating conditions. Effort is also made to present an insight into the predicted control system performance under various plant conditions. Control system performance is predicted for more probable or "best estimate" plant design parameters for various times throughout core lifetime and may be indicative of what may be expected under actual plant operation. The sensitivity of control system performance to various control parameter set points is also indicated to give the operator a feel for possible adjustments in control system parameters to improve certain aspects of plant transient response. Author (NSA)

N67-17529# Japan Atomic Energy Research Inst., Tokyo.
JP-HYDRO: A CODE FOR THE STUDY OF THE THERMAL-HYDRODYNAMICS IN A NATURAL-CIRCULATION, BOILING-WATER NUCLEAR REACTOR
Kin-ichi Moriguchi, Atsuo Kosaka, Yasushi Kuge, and Tetsuo Kobori 1966 16 p In JAPANESE; ENGLISH summary
(JAERI-1108)

A series of steel models having single nozzles radially and nonradially attached to a spherical shell was examined by means of strain gauges. Parameters studied were nozzle dimensions, length of internal nozzle protrusions, and angles of attachment. The loads are internal pressure, axial thrust, and moment loadings on the nozzle. Both experimental and theoretical results from six of the configurations having radially attached nozzles for which the sphere dimensions are equal and the outside diameter of the attached nozzle is constant are given. In some instances the nozzle protrudes through the vessel. Author (NSA)

N67-17536# Societe des Forges et Ateliers du Crusot (France).
THE USE OF AUSTENITIC STEEL AS CONSTRUCTION MATERIAL FOR THE PRESSURE VESSEL OF THE FAST REACTOR "RAPSODIE"
A. Guegnaud and C. Roques Aug. 1964 37 p refs Transl. into ENGLISH from the FRENCH Presented at the Symp. on Mater. for Sodium-Cooled Reactors, New York, 19 Nov. 1963
(Contract EURATOM-006-62-1 RAAF)
(EURFNR-92F; CEA-TP-1593; CONF-777-1; EUR-1642.f) CFSTI: HC $3.00/MF $0.65

Various factors which determine the selection of the base metal and the weld metal for the Rapsodie pressure vessel and sodium pipes are examined. High temperature creep, loading, and ductility properties are examined for stainless steels containing additional elements in small quantities. Creep and fracture properties are described for welded joints subjected to long-term tests. NSA

N67-17540# Atomics International, Canoga Park, Calif.
RESEARCH AND DETERMINATION OF RATES OF LEAKAGES OF NUCLEAR FUEL ELEMENTS
M. N. Block and J. O. de Greeff Jan. 1964 28 p Transl. into ENGLISH from EURATOM Commun. No. 688
(AI-TRANS-206)

Nondestructive testing of nuclear fuel elements during and after the canning procedure is described. A review is given of existing detectors followed by a discussion of the signal interpretation problem, when adsorption has to be taken into account. Formulas are given for the different cases of leak rates and the Radiflo leak test is described. Author (NSA)

N67-17543# Oak Ridge National Lab., Tenn.
OPTIMIZATION OF REACTORS SHUTDOWN MARGIN MEASUREMENTS IN HIGH GAMMA FLUXES
D. P. Roux [1966] 5 p refs Presented at the 14th Conf. on Remote Systems Tech., Pittsburgh
(Contract W-7405-ENG-26)
(ORNL-P-2311; CONF-661001-18) CFSTI: HC $3.00/MF $0.65

An equation is derived to quantitatively predict the degrading effect of gamma background from fission products on the quality of reactor shutdown margin measurements made by neutron noise analysis. Ionization chamber characteristics were optimized using the results of this analysis. NSA

N67-17545# Atomic Energy Establishment, Trombay (India).
APPARATUS FOR THE THERMAL CONDUCTIVITY DETERMINATION OF SOME ORGANIC COOLANTS USED IN NUCLEAR REACTORS
K. Natarajan, M. P. S. Ramani, and D. G. Vartak 1966 26 p refs
(AEET-245)

A suitable apparatus for measuring thermal conductivity of organic liquids used in nuclear reactors is described. The apparatus was first used to determine the thermal conductivity of water and nitrobenzene. Then the thermal conductivity of reactor coolants such as Dowtherm, Santowax O.M., monoisopropyl biphenyl, o-terphenyl, m-terphenyl, p-terphenyl and Santowax-R were determined and values compared with those available in the literature. NSA

N67-17553# Southwest Research Inst., San Antonio, Tex.
TENSILE AND IMPACT PROPERTIES OF LACBWR REACTOR VESSEL PLATE AND CONTROL MATERIAL
E. B. Norris 12 Aug. 1966 15 p
(Contract AT(11-1)-1228)
(SWRI-1228-7-35) CFSTI: HC $3.00/MF $0.65

Test results on Charpy V-notch and tensile specimens for LaCrosse Boiling Water Reactor pressure vessel materials are reported. These specimens were tested before and after irradiation. Data are included on the radioinduced nil ductility transition temperature and Charpy V-notch fracture energies. NSA

N67-17556# Los Alamos Scientific Lab., N. Mex.
ADVANCED REACTOR TECHNOLOGY (ART) Quarterly Status Report, Period Ending 30 Jul. 1966
Aug. 1966 72 p refs
(Contract W-7405-ENG-36)
(LA-3582) CFSTI: HC $3.00/MF $0.65

Further developments in the components of the Fast Reactor Core Test Facility are described. A brief discussion of fast reactor physics is also presented. The status of the irradiation experiments on OWREX is described. Results of corrosive tests of carburized and uncarburized Ta and Nb alloys in Pu–Co–Ce molten alloys are described. NSA

N67-17557# Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet (France).
[ON REACTOR ENGINEERING] Quarterly Report, 1 Jan.–31 Mar. 1966
31 Mar. 1966 19 p
(TID-23339; EUR/C/2444/66.e; QR-15) CFSTI: HC $3.00/MF $0.65

Further research developments on the SENA reactor are described with respect to design studies, prefabricated components, and on-site work. NSA

N67-17558# Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet (France).
[ON REACTOR ENGINEERING] Quarterly Report, 1 Oct.–31 Dec. 1965
28 Feb. 1966 27 p
(TID-23338; EUR/C/1380/66.e; QR-14) CFSTI: HC $3.00/MF $0.65

Further research developments on the SENA reactor are described with respect to design studies, prefabricated components, on-site work, tests, work schedule, and documentation. NSA

N67-17560# Los Alamos Scientific Lab., N. Mex.
LIQUID PLUTONIUM FUELS
L. D. Kirkbride [1966] 30 p refs Presented at the AIME Nucl. Metal. Symp. on High Temp. Nucl. Fuels, Delevan, Wis.
(Contract W-7405-ENG-36)
(LA-DC-7581; CONF-661003-1) CFSTI: HC $3.00/MF $0.65

Commercial fast breeder reactor designs presently contemplated would utilize a fuel system of Pu–Co–Ce alloy. Results are presented of several research projects involved in developing the Pu–Co–Ce fuel system. One project is concerned with establishing a corrosion resistant container for liquid Pu alloys. Tests to date have encompassed fuel concentrations from 5 to 8 g Pu/cc in contact with Ta and Ta–W alloys up to 10 wt % W and at temperatures up to 1100°C. The results of these tests indicate that container walls are not penetrated by the diffusion of Pu in grain boundaries but only untreated welds are subject to such penetration. Irradiation results obtained to date are all favorable. A brief description of some results obtained in LAMPRE-I (a 1 MW(t) fast reactor, fueled with Pu–Fe eutectic alloy) is given. Current investigations are concentrated on ascertaining the effect of fission product recoil from Pu–Co–Ce alloys on the damage to both Ta and Ta(W)–C layers by testing in the OWR, a 5 Mw(t) thermal flux research

reactor. A significant finding is that all wall fission densities of up to 8×10^{20} fissions/cc, fission products recoiled into the tantalum alloy container walls are seen to concentrate and diffuse in particular crystallographic planes to a depth of <2.5 mils. NSA

N67-17566# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART X: A LITERATURE SURVEY ON THE PROPERTIES OF TELLURIUM, ITS OXYGEN AND FLUORINE COMPOUNDS
D. R. Vissers and M. J. Steindler Feb. 1966 81 p refs
(Contract W-31-109-ENG-38)
(ANL-7142) CFSTI: HC $3.00/MF $0.65

The results of a literature survey of the properties of tellurium, its oxides, fluorides, and oxyfluorides have been assembled. The pertinent data for the physical and chemical properties as well as the behavior of tellurium in processing of nuclear fuels by fluoride volatility methods are included. An appendix containing tabulated vapor pressures and abstracts (149) of all pertinent references is furnished. 111 references. Author (NSA)

N67-17572# Atomics International, Canoga Park, Calif.
COLD NEUTRON EFFECTS IN GRAPHITE DIFFUSION MEASUREMENTS
J. A. DeJuren and V. A. Swanson 1 Mar. 1966 23 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11866) CFSTI: HC $3.00/MF $0.65

Diffusion length measurements were made in AGOT graphite as a function of transverse buckling. For bucklings greater than $3.5 \times 10^{-3} cm^{-2}$, spectral equilibrium is not attained between a predominantly thermal neutron group and a cold neutron group beyond the Bragg cutoff. The presence of cold neutrons cause a distinct increase in the measured extrapolation length. A treatment is given for the variation of the steady-state diffusion length with buckling for a Maxwellian spectrum whose temperature is modified by leakage. Author (NSA)

N67-17574# Oak Ridge National Lab., Tenn.
THERMODYNAMIC FUNCTIONS OF NUCLEAR MATERIALS: UC, UC_2, UO_2, ThO_2, AND UN
T. G. Godfrey, J. A. Woolley, and J. M. Leitnaker Oct. 1966 23 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1596) CFSTI: HC $3.00/MF $0.65

The thermodynamic functions, $H_T - H_{298}$, C_p, S_T, and $(F_T - H_{298})/T$, of five compounds of nuclear interest (UC, UC_2, UO_2, ThO_2, and UN) were calculated from literature data and tabulated at 100° increments. Estimates of accuracy are included. The fit of the original enthalpy data to the calculated curve is shown graphically in each case. Author (NSA)

N67-17575# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
STUDY OF THE RELASE OF FISSION GASES FROM UO_2 SAMPLES IRRADIATED WITH DIFFERENT DOSES Quarterly Progress Report, Jan.–Mar. 1966
V. Baffigo and T. Gerevini, comp. May 1966 14 p refs Transl. into ENGLISH from Italian
(Contract EURATOM-043-65 TEEI)
(EURAEC-1667; EUR-2859; M-418; QPR-2) CFSTI: HC $3.00/MF $0.65

Modification and maintenance work was continued on the fission gas apparatus set up in the hot cell for handling highly irradiated specimens. The operation of the apparatus for the measurement of fission gases released from small samples has been delayed because of diffusion furnace rig leaks. An experiment on an M.M.N. UO_2 specimen (fraction 0.3–05. mm) was completed. Evaluation of the results is being performed. Eighteen samples are being irradiated at a neutron flux of approximately 5×10^{13} n/cm^2-sec. Author (NSA)

N67-17582# Los Alamos Scientific Corp., N. Mex.
AN IRRADIATION CAPSULE FOR MOLTEN Pu ALLOYS
P. J. Peterson [1966] 10 p ref Presented at Intern. Symp. on Capsule Irradiation Expt., Pleasanton, Calif.
(Contract W-7405-ENG-48)
(LA-DC-7772; CONF-660511-10) CFSTI: HC $3.00/MF $0.65

Design of a static capsule for use in studying fission product distribution between molten Pu fuel and Na in reactor-type environments is described. The Pu fuel alloy is contained in a sealed Ta pin. Results of testing the design are discussed. NSA

N67-17588# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Monthly Progress Report, Jul. 1966
26 Aug. 1966 81 p refs
(Contract W-31-109-ENG-38)
(ANL-7245) CFSTI: HC $3.00/MF $0.65

Technical progress in specific reactor projects, and in general engineering research and development programs is reported. Such areas as plutonium utilization, fuel development, fuel processing, and sodium technology are discussed for the liquid-metal fast breeder reactors. General reactor research incorporated fuels and cladding materials, radiation damage to structural materials, techniques of fabrication and testing, determinations of the engineering properties of reactor materials, and chemistry and chemical separation studies. Advanced systems research and development included physics experiments and analyses, fuel and core development, and component development. Irradiated fast reactor oxide fuel pins, meltdown experiments, materials behavior, and effluent control was investigated relative to reactor safety. C.T.C.

N67-17687# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
A COMPUTER PROGRAM FOR THE OPTIMIZATION OF ORGANIC COOLED D_2O REACTORS
James W. Wade Apr. 1966 219 p refs
(Contract AT(07-2)-1)
(DP-1007) CFSTI: HC $3.00/MF $0.65

The portion of the Cost Optimization Program, COP, that is used to design and calculate costs for organic-cooled, heavy-water-moderated power reactor plants is coded in FORTRAN II for an IBM 704 computer. The code is applicable for power reactor plants with electrical outputs of 300, 500, or 1000 Mwe. The main features of the code include: an automatic design of concentric fuel tubes of either UO_2 or UC including the calculation of the operating conditions of the fuel assembly and a determination of the reactivity parameters for a unit cell; the determination of the number of fuel positions and an estimate of the fuel life for several fuel charging strategies; an evaluation of the fuel fabrication costs for the specific fuel assembly design and reactor throughput; the design and cost determination for the major reactor equipment, the building structures, and the reactor auxiliary facilities; an automatic optimization of the turbine plant conditions and of the steam generator design; and a final editing of the reactor plant generator design; and a final editing of the reactor plant conditions, and the capital, fuel, and operating components of the total electrical power costs. Author (NSA)

N67-17692# Douglas United Nuclear, Inc., Richland, Wash.
CONFINEMENT SYSTEMS TESTS PERFORMED DURING DEACTIVATION OF THE 100-F REACTOR
Marvin L. Smith 21 Jul. 1966 30 p Presented at the 9th Air Cleaning Conf., Boston
(Contract AT(45-1)-1857)
(DUN-SA-15; CONF-660904-12) CFSTI: HC $3.00/MF $0.65

Permanent shutdown of 100-F Pu production reactor at Hanford made the system for confining the particulate and halogen, in the exhaust air, available for testing. Results are shown for tests on I_2 deposition from the airstream, I_2 removed from airstream by fog spray, encapsulation of the reactor exhaust air in foam, effectiveness of fog spray for removing noble gases from the air and effectiveness of the filter system for removing I_2, from the exhaust air. Author (NSA)

N67-17697# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
DYNAMIC CORROSION FOR THE HIGH FLUX ISOTOPE REACTOR
J. L. English and J. C. Griess Sep. 1966 43 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1030) CFSTI: HC $3.00/MF $0.65

The results of a testing program to examine the long-term corrosion behavior of materials of interest to the High Flux Isotope Reactor (HFIR) are presented, and their significance to the operation of the HFIR is discussed. The test environment was water, adjusted to a pH of 5.0 with HNO_3, at 100°C and at flow rates ranging from 0.5 fpm to 81 fps. Under all flow conditions, the Al alloys corroded at low rates, 0.2 mpy at the higher velocities and less than 0.1 mpy at the lowest velocities. Contacting Al with Al, Be, Ni, types 304, 416, 420, or 17-4PH stainless steel resulted in pitting of the Al in the contact areas only. While of appreciable depth, the pits were randomly spread and should not be of major consequences in the HFIR system. Be, both by itself and in contact with other metals, was subject to light pitting attack. Pits did not exceed 13 mils in depth in tests that lasted in excess of one year. Within the velocity range of 13 to 81 fps, the average corrosion rate of Be was independent of velocity and constant at 2 mpy. One specimen of Be in contact with type 304 stainless steel developed evidence of stress-corrosion cracking. Commercial-grade Ni underwent shallow pitting attack and corroded at an average rate of 2 mpy. An electroless Ni deposite on 6061 Al corroded at the high rate of 19 mpy. Electrolyzed coatings (a proprietary process for coating materials with Cr) on stainless steel exhibited excellent corrosion resistance and good adherence to the stainless steel. Similar deposits flaked and peeled from Al surfaces. Hardened type 416 stainless steel was subject to blistering while type 420 stainless steel underwent stress-corrosion cracking. Delrin, a polyformaldehyde plastic considered as a gasket material, suffered near-complete degradation after a short time in test. NSA

N67-17698# Atomics International, Canoga Park, Calif.
DOLTL: A COMPUTER CODE TO CALCULATE TEMPERATURE DRIFT FOR STATISTICALLY CONTROLLED SNAP 10A TYPE REACTORS
L. D. Swenson and K. R. Birney 11 Apr. 1966 15 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11977) CFSTI: HC $3.00/MF $0.65

The analytical modal used in the DOLTL computer code to calculate the temperature drift for SNAP 10A reactors is presented. The model allows an active control period of specified length followed by static (hands off) control for the remainder of the operating period. The model treats the following mechanisms of reactivity change as a function of power and/or temperature: 149Sm prepoison burnout and fission product 149Sm buildup, H_2 leakage from the fuel elements, H_2 redistribution within the fuel elements, fission product accumulation (other than 135Xe and 149Sm) and 235U depletion, and changes in equilibrium 135Xe worth. Author (NSA)

N67-17724# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report
25 Jan. 1966 89 p refs
(Contract W-31-109-ENG-38)
(ANL-7132) CFSTI: HC $3.00/MF $0.65

Three separate EBR-II runs were made during this period. New theoretical calculations by the THERMOS code using cylindrical one-dimensional 4-group diffusion theory calculations led to value of 20.1 elements for the initial clean critical mass of the plutonium zone as compared with the experimentally used 22 elements. The boric acid concentration needed for criticality with the 36 element loading was calculated to be 5.14 g/gal as compared to the non-THERMOS calculation of 7 g/gal and an experimental value of 5.09 g/gal. The maximum reactivity effect of voiding of the ITC to various degrees was measured in the criticality facility using the 810-fuel-plate, 810-poison-strip loading. The maximum effect is 1.5% reactivity at 50% voids. For the physics reference preliminary core design, reactivity control by xenon and samarium was computed at 2.85% for 100 MW and 3.5% for 240 MW operation. Improved circuitry for control drive magnetic clutch scram actuation reduced the time from power interruption to initial rod motion to 4 msec. The nuclear instrumentation design and placement were modified in coordination with beam tube space requirements. R.N.A.

N67-17801# Aktiebolaget Atomenergi, Stockholm (Sweden).
BURN-UP DETERMINATION BY HIGH RESOLUTION GAMMA SPECTROMETRY: SPECTRA FROM SLIGHTLY IRRADIATED URANIUM AND PLUTONIUM BETWEEN 400–830 KeV
R. S. Forsyth and N. Ronqvist Aug. 1966 23 p refs
(AE-241) CFSTI: HC $3.00/MF $0.65

In this report fission product spectra of irradiated uranium and plutonium are presented which are obtained by means of a lithium-drifted germanium detector. The resolved gamma peaks have been assigned to various fission products by correlation of measured energy and half-life values with published data. By simultaneous study of the spectra of two irradiated mixtures of plutonium and uranium, the possibility of using the activities of Ru-103 and Ru-106 as a measure of the relative fission rate in U-235 and Pu-239 has been briefly examined. Author (ESRO)

N67-17843# Reactor Centrum Nederland, Petten.
LOW TEMPERATURE IRRADIATION OF STEELS FOR REACTOR PRESSURE VESSELS
A. Hanevik and T. Larsen Jul. 1966 40 p refs Prepared jointly with Inst. for Atomenergi
(RCN-57) CFSTI: HC $3.00/MF $0.65

The Norwegian-Dutch steel irradiation program comprises the investigation of the radiation damage in different pressure vessel steels. Each steel type is irradiated to different integrated fast neutron fluxes (fast fluence) (>0.1 MeV) between about 5×10^{17} and 10^{20}n/cm^2 and at a temperature of 60°C. Four different steels as plate materials have been irradiated together with their respective weld and heat affected zone materials. The steels are T-1 (American), Ducol W-30 (English), R 3/2103 (Swedish) and 1,2 MD07 (French). The change in tensile and impact strength properties has been investigated. Experimental results showing the increase in transition temperature and tensile strength properties with increasing fast neutron fluences are presented. Author (ESRO)

N67-17886# Atomics International, Canoga Park, Calif.
FAST NEUTRON WEIGHTING FACTORS FOR MANRATED SNAP REACTOR APPLICATIONS
G. W. Spangler 20 Apr. 1966 18 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11901) CFSTI: HC $3.00/MF $0.65

A review of the RBE problem is presented, and its relation to fast neutron weighting factors for SNAP manrated reactor systems is discussed. Reasonably justified fast neutron weighting factors can be specified for particular SNAP reactor applications; however, there is insufficient experimental justification for a firm specification of general weighting factors. Author (NSA)

N67-17902# FIAT S.p.A., Turin (Italy). Sezione Energia Nucleare.
ANALOG SIMULATION OF A PRESSURIZED WATER NUCLEAR POWER PLANT WITH THE SPACE-TIME CORE EQUATIONS [SIMULAZIONE ANALOGICA DI UN IMPIANTO NUCLEARE AD ACQUA IN PRESSIONE CONTENENTE LE EQUAZIONI SPAZIO-TEMPORALI DEL NOCCIOLO]
C. Bona (EURATOM), F. Jacovoni (Comitato Nazl. per l'Energia Nucl.) and G. P. Pozzi Brussels, EURATOM, Sep. 1966 194 p refs In ITALIAN; ENGLISH summary Prepared jointly with EURATOM, Ansaldo S.p.A., and Comitato Nazl. per l'Energia Nucl.
(Contract EURATOM-008-61-12 PNII)
(EUR-3112.i) CFSTI: HC $3.00/MF $0.65

The plant, as simulated on the analog computer, is the nuclear power plant for ship propulsion. The core has been subdivided into several cells; on each cell the neutron kinetics equations with one delayed neutron group coupled with the thermohydraulic equations have been applied. These equations have been correlated with the others describing the plant including the steam generators. Transients as load changes in turbine and full power control rod withdrawal have been investigated. Author

N67-17953# United Kingdom Atomic Energy Authority, Springfields (England).
THE EFFECT OF MILLING UPON THE MICROSTRUCTURE OF URANIUM DIOXIDE POWDER
I. F. Ferguson 1966 25 p refs Reprinted
(TRG-1261 (S)) HMSO: 4s 6d

The effect of milling a uranium dioxide powder has been examined by X-ray line broadening studies, B.E.T. surface area measurements, and electron microscopy. It is shown that milling breaks down the agglomerates, particles and crystallites in the powder and regularizes the shape of the latter. The initial milling decreases crystal lattice strain. It is believed that this strain is associated with the irregular necked shape of the crystallites. Further milling in air causes a steady increase in the strain. It is believed that this increase is associated with the progressive contamination of the powder with α-U_3O_7 which is caused by oxidation. Author

N67-17958# Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England).
THE EFFECT OF A TENSILE RESTRAINT ON GRAPHITE SPECIMENS IRRADIATED IN BR-2
J. E. Brocklehurst, A. A. McFarlane 1966 28 p refs
(TRG-1279(C)) HMSO: 4s 6d

Specimens of near-isotropic graphites, in the form of rings restrained from shrinking at the inner bore by a mandrel have been irradiated in BR-2, at about 400°C. The net specimen strain rate depended on the rate of irradiation-induced shrinkage and the temperature changes during each reactor cycle. It is shown that at least 0.6% plastic strain may be absorbed in tension without cracking, even when strain is applied for part of the time at rates 2 to 3 times the normal shrinkage rate. The strength of such specimens is not reduced below the unirradiated value by the presence of creep strain. Temperature transients due to operational difficulties caused the development of radial cracks in some specimens, of which a few failed completely. Thus tensile failure appears to be preceded by the development of such fine cracks. Author

N67-18055# Boeing Scientific Research Labs., Seattle, Wash.
DESIGN AND OPERATION OF THE BSRL PEBBLE BED HEATER-WINDTUNNEL FACILITY
Raymond P. Shreeve and J. K. Richmond Oct. 1966 47 p refs *Its* Flight Sci. Lab. Rept.-110
(D1-820577)

The BSRL pebble bed heater-windtunnel facility was designed with the primary object of providing a means of studying problems associated with combustion in supersonic flow. Selected was a blowdown windtunnel using a storage heater. An appraisal of air heaters of the storage type throughout, led to the selection of a pebble bed heater using, for the present, alumina refractories. This type of heater will provide gas temperatures of up to 3,000°R. Having selected the type of heater necessary for experiments in supersonic combustion, the associated compressed air supply, the various pieces of hardware were designed to permit a range of future applications of the equipment. Also, the pebble bed pressure vessel was stressed for 1500 psi working pressure to allow high stagnation pressures (not necessary in the supersonic combustion tunnel), to be used in the hypersonic tunnel. Author

N67-18064 European Atomic Energy Community, Ispra (Italy). Scientific Data Processing Center.
DIGITAL SOLUTION OF THE INTEGRAL TRANSPORT EQUATION IN THE ONE-VELOCITY AND ISOTROPIC SCATTERING APPROXIMATION FOR A SQUARE CELL CONTAINING A FOUR-ROD CLUSTER ELEMENT [RISOLUZIONE NUMERICA DELL'EQUAZIONE INTEGRALE DEL TRASPORTO NELL'APPROSSIMAZIONE A UNA VELOCITA E SCATTERING ISOTROPO, PER UNA CELLA QUADRATA CONTENENTE UN ELEMENTO A CLUSTER DI QUATTRO BARRETTE]
R. Corona and B. Montagnini Brussels, EURATOM, Sep. 1966 70 p refs In ITALIAN; ENGLISH summary
(EUR-3124.i) CFSTI: $3.00

This report is devoted to a numerical solution of the one-velocity integral transport equation in two-dimensional x-y geometry. A single, but realistic problem is considered: a square cell with a four-rod cluster fuel element. The IBM 7090 code ZIP ZIP 3 here presented evaluates the pointwise flux in the cell and the average fluxes in the fuel and the moderator. Author

N67-18065 Gesellschaft fur Kernenergieverwertung, Hamburg (West Germany).
SHIELDING EXPERIMENTS AT THE REACTOR STATION GEESTHACHT Annual Report, 1965 [ABSCHIRMUNG-SEXPERIMENTEAM FORSCHUNGSREAKTOR GEESTHACHT Jahresbericht, 1965]
E. Bagge, E. Fischer, D. Buenemann, T. B. Enginol, R. Fiebig et al Brussels, EURATOM, Aug. 1966 226 p refs In GERMAN; ENGLISH summary Prepared in Cooperation with EURATOM and M. A. N. Werk
(Contract EURATOM-002-61-1-PNID)
(EUR-2960.d) CFSTI: $3.00

Shielding studies were conducted in three experimental facilities. The experiments involved a collimated beam and two irradiation channels. Various shielding arrangements were tested to evaluate volumetric composition of the shielding materials, geometric factors, and accuracy of measurements. Measuring equipment and apparatus used in the experiments were improved and perfected, including scintillation pair spectrometers, coincidence detectors, and semiconductor devices for neutron and gamma spectra measurement. The efficiency of shielding devices was calculated in theoretical studies. Transl. by K.W.

N67-18066# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.
A REVIEW OF THERMAL NEUTRON SCATTERING EQUIPMENT AT A.E.R.E., HARWELL. PART I: ELASTIC SCATTERING APPARATUS
R. F. Dyer Sep. 1966 34 p refs
(AERE-R-5259, Pt. 1) HMSO: 4s 6d

This review covers the main items of equipment used in neutron scattering experiments and includes a description of the ancillary equipment available for use with the basic instruments. Author

N67-18067# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.
A REVIEW OF THERMAL NEUTRON SCATTERING EQUIPMENT AT A.E.R.E., HARWELL. PART 2: INELASTIC SCATTERING APPARATUS
R. F. Dyer Sep. 1966 21 p refs
(AERE-R-5259, Pt. 2) HMSO: 3s

This review covers time-of-flight and triple axis spectrometers for neutron inelastic scattering work together with a section on cryostats, furnaces, and magnets. Author

N67-18076# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
IRON AS A FAST-NEUTRON MONITOR
P. Carter Oct. 1966 27 p refs
(AERE-M-1778)

The techniques for the use of the $Fe^{54}(n,p)Mn^{54}$ reaction in natural iron as a long-term fast-neutron monitor are described. The additional $Fe^{58}(n,\gamma)Fe^{59}$ thermal-neutron reaction may be used in shorter irradiations for obtaining thermal-neutron doses. Since large numbers of monitors are required the monitors are chosen to be in the form of wires, weighing 1.6 mgm. The activities of the Mn^{54} and Fe^{59} components present in the irradiated monitors are measured, without recourse to chemical separation, by means of a gamma-ray scintillation spectrometer fitted with a gain-stabilization system to enable reliable comparison of spectra. The activities are determined with respect to standard sources of Mn^{54} and Fe^{59}. The nuclear data used for the analysis of the $Fe^{54}(n,p)Mn^{54}$ reaction is an activation cross-section of 78 mb and a 313.5 day half-life for the Mn^{54} nuclide, and for the $Fe^{58}(n,\gamma)Fe^{59}$ reaction a 2200 m s^{-1} cross-section of 1.09 barns and a 45.1 day half-life. Relative flux measurements can be made to within ±1%. Absolute flux values cannot be determined within ±3% in the case of the fast-neutron flux and ±4% for the thermal-neutron flux, the chief causes of error being in the value for the integral cross-section and absolute activity measurements. Author

N67-18077# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
THE DETERMINATION OF THE FAST-NEUTRON SPECTRUM IN THERMAL REACTORS BY USING LITHIUM-6 AND HELIUM-3 SEMICONDUCTOR SPECTROMETERS
M. G. Silk Sep. 1966 62 p refs
(AERE-R-5183)

A lithium-6 loaded sandwich type semiconductor neutron spectrometer has been used to determine fast neutron spectra in the low-power reactors DAPHNE, LIDO, and GLEEP. The spectrum from a plutonium-beryllium fast neutron source has also been studied. The resultant spectra are shown to be in good agreement with spectra calculated by Monte Carlo techniques and with spectra obtained by others where these are available. The sources of error and the potential application of this method of neutron spectrometry are also considered. Author

N67-18111 Joint Publications Research Service, Washington, D. C.
OPERATING EXPERIENCE WITH THE SM-2 RESEARCH REACTOR
V. A. Tsykanov 9 Jan. 1967 15 p refs Transl. into ENGLISH from Kernenergie (Dresden), v. 9, no. 10, Oct. 1966 p 310-315 Presented at the 4th Working Conf. on the Phys. and Technol. of Res. Reactors, Budapest
(JPRS-39447; TT-67-30097)

Increasing the height of the active zone, radiation stability of the materials used, and principal changes in the auxiliary systems of the SM-2 research reactor are discussed on the basis of operating experience. The last deals with replacement of gas compressors of the ejector device, conversion of the special purification system to a high pressure closed scheme, separation of the water loops from the main water and gas circuit, merger of the two water loops into one, and conversion of the system for inspecting the cassette hermeticity to a closed scheme. M.W.R.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-16799# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
TRANSMISSION LINE MODELS OF MAGNON-PHONON MODES IN FERRITES. PART I: UNCOUPLED MODES
James C. Sethares Sep. 1966 24 p refs *In*: Phys. Sci. Res. Papers No. 262(I)
(AFCRL-66-633(I); AD-641638) CFSTI: HC $3.00/MF $0.65

Tranamission line models for describing the behavior of certain magnon-phonon modes in ferrites are developed. The analogies between magnon-phonon and transmission line variables apply to other modes as well. Models for circularly polarized shear waves and magnons are described in detail. Voltage and current variables are defined in terms of magnetic and mechanical variables and the distributed transmission line elements are related to material parameters. Some examples of the use of the models are given. Author (TAB)

N67-16916*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LOW-TEMPERATURE EFFECTS ON MATERIALS FOR AEROSPACE MECHANISMS
Warren E. Henry *In*: Santa Clara Univ. Aerospace Mech. 20 May 1966 p 167-180 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

Advantages of low-temperature technology are: (1) the avoidance of mechanical or other failures in spacecraft which are normally subjected to low temperatures; (2) the greater sensitivity and increased resistance to fatigue of devices under low-temperature conditions, with improved performance compared to that possible at higher temperatures; and (3) the special unique properties evidenced by certain materials under low temperature conditions. This study encompasses the cataloging, evaluation, and correlation of properties. Suggestions and examples of applications of cryogenic materials are given, including superconducting gyroscopes, high-sensitivity indicators, and high-reliability aerospace mechanisms. Author

N67-16996# Air Force Special Weapons Center, Kirtland AFB, N. Mex.

ELECTROMAGNETIC PULSE (EMP) GENERATION AND MEASUREMENT

George R. Riling and Stephen T. Negler *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. III [1966] 31 p refs (See N67-16986 07-34) CFSTI: HC $3.00/MF $0.65

This paper portrays the in-house capabilities of the Air Force Special Weapons Center to conduct simulated electromagnetic pulse tests. The equipment and techniques used for conducting these tests and the sensors used to monitor the environment are described. In order to overcome the restrictions imposed by the *test ban treaty, the large mobile surge generator was developed to* simulate these postulated environments. The theory of operation of Marx surge generators and the actual mechanical and electrical parameters of the generators are given. An electromagnetically shielded room was constructed in a van to isolate the recording instrumentation for the electric and magnetic field sensors from the fields produced by the generators. A description of this screen room and the field measuring equipment is included. The Air Force Special Weapons Center possesses the unique capability to subject an operational weapon system to an electromagnetic environment due to the mobility of its equipment. A field test was conducted which demonstrated the ability of the system to produce the high-level pulses necessary to simulate the nuclear EMP environment. Author

N67-17003# Columbia Univ., New York. Dept. of Electrical Engineering.

FORMAL SOLUTION TO MAXWELL'S EQUATIONS FOR GENERAL LINEAR MEDIA

P. Diament In its Surface Wave Guiding and Radiating Systems Jun. 1966 p 4 ref (See N67-17001 07-25) CFSTI: HC $3.00/MF $0.65

A summary account is given of the reformulation of Maxwell's equations for linear media through linear operator and generalized transform techniques into an equivalent matric integral equation. It was pointed out that the formal solution unifies and systematizes the analysis of a general class of problems in electromagnetic theory and reduces such problems to quadratures. The results are applicable to time-invariant, linear media which may be inhomogeneous, anisotropic, nonuniform, dissipative, dispersive, with any source distribution. L.E.W.

N67-17200# IIT Research Inst., Chicago, Ill. Technology Center.

CONTINUOUS FACSIMILE SCANNER EMPLOYING FIBER OPTICS Quarterly Report, 1 Oct.–31 Dec. 1965

Donald A. Pontarelli 5 May 1966 13 p

(Contract DA-28-043-AMC-00164(E))

(IITRI-A6093-18; QR-6; ECOM-00164-6; AD-643074) CFSTI: HC $3.00/MF $0.65

Work was continued on the selection, design and construction of the mechanical, electrical and optical components necessary to produce a functional facsimile transmitter. The major accomplishments during the report period were: (1) Design of a unitized prototype facsimile scanner. (2) Acquisition and classification of photodetector data. Author (TAB)

N67-17253# Brown Univ., Providence, R. I. Div. of Engineering.

ATTENUATION AND DISPERSION OF SOUND IN AN AEROSOL Final Report, 2 Mar. 1964–31 Aug. 1966

Richard A. Dobbins Oct. 1966 11 p refs

(Contract Nonr-562(37))

(AD-641013) CFSTI: HC $3.00/MF $0.65

The report describes the research performed on the subject of the attenuation and dispersion of sound in an aerosol. A list of technical reports and publications is included. Author (TAB)

N67-17439# Illinois Univ., Urbana.

MAGNETIC PROPERTIES OF DILUTE SOLUTIONS OF LIQUID He^3 IN He^4 AT LOW TEMPERATURES

Raymond Joseph Sarwinski (Ph.D. Thesis) Aug. 1966 125 p refs

(Contract AT(11-1)-1198)

(COO-1198-382) CFSTI: HC $3.00/MF $0.65

The spin–diffusion coefficient and magnetic susceptibility of dilute solutions of ^3He in ^4He were measured down to about .003°K. These measurements were made on two solutions of nominal concentrations of 1.3% and 5.0% ^3He in ^4He under their own vapor pressures. The values of the diffusion coefficient fit T^{*-2} laws below about .01°K for the 1.3% and below about .03°K for the 5.0% solutions in agreement with the Landau model of a Fermi liquid. The susceptibility is found to be constant at sufficiently low temperatures also in agreement with the Landau model. Dilute solutions of ^3He in ^4He are found to behave as weakly interacting Fermi systems with the advantage that the concentration, and therefore the Fermi temperature, can be varied from 0 to about 6% ^3He. Since the system is weakly interacting, perturbation theory can be applied and the effective interaction potential between ^3He particles can be deduced from measurements of the properties of these solutions at different concentrations. Author (NSA)

N67-17447# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).

PERTURBATION OF MAGNETIC SURFACES [VOZ MYSHCHENIYA MAGNITNYKH POVERKHNOSTEI]

L. S. Solovev and V. D. Shafranov [1966] 8 p In RUSSIAN

(IAE-1150)

The equation of magnetic surfaces $\psi(\vec{r}) = \text{const}$ is determined as a definite integral of the differential equation $\vec{B} \nabla \psi = 0$. The solution of this equation in the general case is a difficult problem, but is possible by use of a perturbation method. The magnetic field is represented by the set: 1) $\vec{B} = \vec{B}_0 + \vec{B}_1 + \vec{B}_2 + \ldots$. On assuming 2) $\psi = \psi_0 + \psi_1 + \psi_2 + \ldots$, the following set of equations is obtained by successive approximations: 3) $\vec{B}_0 \nabla \psi_0 = 0$, 4) $\vec{B}_0 \nabla \psi_1 = -\vec{B}_1 \nabla \psi_0$, and 5) $\vec{B}_0 \nabla \psi_2 = -\vec{B}_1 \nabla \psi_1 - \vec{B}_2 \nabla \psi_0$. Equations 4 and 5 have the form $\vec{B}_0 \nabla \psi = S$, where $\vec{B}_0$ and S are known, and ψ can be determined. A set of toroidal magnetic surfaces can be derived, and these magnetic surfaces are perturbed by introducing the polar variables θ and η. A definite solution is obtained by assuming the absence of an average radical magnetic field, and the absence of resonance perturbations. In the presence of a wide gap the magnetic surfaces split up under the effect of resonance perturbations with $m = 2$ and 3, and form rosettes and fibers. The relative dimensions of the figures are given. NSA

N67-17448# Atomics International, Canoga Park, Calif.

PHYSICAL PROPERTIES OF STEAM AND WATER ABOVE 1000 psia

D. Logan 6 Jun. 1966 15 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-12006) CFSTI: HC$3.00/MF$0.65

Lack of readily available physical property data for water and steam at pressures and temperatures needed for the once through steam generator necessitated a literature survey. The literature survey clearly brought forth the fact that most of the physical properties at least for steam are not clearly established. Different experimental investigations resulted in large disagreements of more than a factor of two. Consequently, the most reliable data were chosen to be presented. The physical properties included are the specific heat, viscosity, and thermal conductivity of steam and water at pressures above 1000 psia. Also given are the density and Prandtl Moduli for water at elevated pressures. NSA

N67-17627# Commissariat a l'Energie Atomique, Saclay (France).
CRYOGENIC EQUIPMENT [MATERIAL CRYOGENIQUE]
Louis Leger, Jean Javellaud, Claude Caro, Roger Gilguy, and Olivier Testard Jun. 1966 33 p In FRENCH
(CEA-R-3008)

The cryostats presented here were built from standard parts; this makes it possible to construct a great variety of apparatus at minimum cost. The liquid nitrogen and helium reservoirs were designed so as to reduce losses to a minimum, and so as to make the cryostats as autonomous as possible. The experimental enclosure which is generally placed in the lower part of the apparatus requires a separate study in every case. Furthermore, complete assemblies such as transfer rods, isolated traps and high vacuum valves, were designed with a similar regard for the economic aspects and for the need for standardization. Author (NSA)

N67-17690# Los Alamos Scientific Lab., N. Mex.
CIRCUIT ANALOG TECHNIQUES FOR ANALYSIS OF RESONANTLY-COUPLED LINEAR ACCELERATOR STRUCTURES
G. R. Swain 2 Sep. 1966 21 p refs Presented at the Linear Accelerator Conf., Los Alamos, N. Mex.
(Contract W-7405-ENG-36)
(LA-DC-8248; CONF-661021-10) CFSTI: HC$3.00/MF$0.65

The application of the circuit analog to the study of resonantly-coupled accelerator structures is discussed. Topics included are the circuit analog; relation of error analysis with direct coupling present to the analysis without direct coupling; and circuit analog experiments by digital computer, effect of increasing the coupling at the drive, effect of a temperature gradient along a chain of cavities, and effect of coupling chains together to form a long chain with multiple drives. NSA

N67-17763# Aeronautical Research Council (Gt. Brit.)
ON THE AXIAL COMPRESSION OF LONG, SLIGHTLY CURVED PANELS
G. G. Pope London, HMSO, 1965 45 p refs Supersedes RAE-STRUCT-291; ARC-25600; see X64-15039
(ARC-R&M-3392; RAE-STRUCT-291; ARC-25600) HMSO: 12s

A finite-deflection analysis is given of the buckling of long, slightly curved panels in compression parallel to the generators, with sides either clamped or simply-supported, and with various combinations of boundary conditions in the middle surface. Author

N67-17786*# Parametrics, Inc., Waltham, Mass.
ACOUSTIC TECHNIQUES AND APPLICATIONS AT ELEVATED TEMPERATURES
Edmund H. Carnevale *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 73-103 refs (See N67-17781 07-14)
GPO: HC$1.00; CFSTI: MF$0.65

Details are given on the various acoustic techniques used to determine the properties of solids, liquids, and gases at temperatures up to about 17,000°K. The methods used to measure the elastic moduli of solids are categorized as resonance, and pulse. Some resonance measurements, including the materials and temperatures investigated, are listed. The pulse method is defined as consisting essentially of measuring the acoustic transit time through a sample of known length at a given temperature. Variations are discussed, including the momentary contact system which provides for complete immersion of the specimen in the high temperature environment with only momentary contact of the transducers. Acoustic measurements obtained in liquids are reviewed. Several examples are given to illustrate the use of an ultrasonic pulse and the momentary contact techniques in measuring gases. Other applications are identified as measuring the ablation rate of reentry heat shield materials and the temperature of nuclear rocket engines, and nondestructive testing at elevated temperatures. M.G.J.

N67-17815# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
A 40kV CONDENSER BANK OF EXTREMELY LOW INTERNAL INDUCTANCE
W. Anger, F. H. Bohn and F. J. Friedrich Apr. 1966 21 p refs
(JUL-374-PP) CFSTI: HC$3.00/MF$0.65

A 15 kJ condenser bank for magnetic compression experiments is described. The operating voltage is 40 kV and the internal inductance 3 nH. The rate of rise of the current under shortcircuit conditions is 1.3×10^{13} A/sec. 60 units, each consisting of a 40 kV/0.31 μF coaxial condenser, a pressurized spark gap, and a special current-conductor, are switched in parallel and connected to the load by means of a two-plate collector system. For the construction of the latter, it was essential to achieve minimum inductance and to obtain a high life time of the insulating foil. These two requirements were fulfilled by choosing an initial insulating thickness of 0.6 mm, and by constructing a highly rigid collector system that allowed a surface planeness of better than ±0.01 mm and an extremely good surface quality. In a coil of 15 cm length and 42 mm diameter, magnetic fields up to 120 kG with a quarter period of 0.65 μsec have been generated. Author (ESRO)

N67-17819# European Space Research Lab., Noordwijk (Netherlands).
SOLAR ECLIPSE OF 20 MAY 1966: ARCAS SOUNDING ROCKET EXPERIMENTS
B. Landmark Paris, ESRO, May 1966 13 p
(ESRO-SN-57 (ESLAB)) CFSTI: HC$3.00/MF$0.65

The scientific experiments carried in Arcas rockets launched in Greece during the solar eclipse of 20 May 1966 are described. They comprise: a Faraday rotation experiment to measure electron densities (R-76, for the Ionosphere Lab., Copenhagen); measurement of positive ion densities by means of a Langmuir probe (R-45 for University College, London); and measurement of the intensity of Lyman-alpha radiation above 60 km (R-123, for the Radio and Space Research Station, Slough). The three experiments were contained in one payload and six Arcas rockets were launched. Author (ESRO)

N67-17876*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
BINARY DIFFUSION IN AN EXPONENTIAL MEDIUM
Mordehai Liwshitz Washington, NASA, Nov. 1966 53 p refs
(NASA-TN-D-3722) CFSTI: HC$3.00/MF$0.65 CSCL 20D

The equation of diffusion of a minor, light gaseous component through an exponential medium is examined. The equation's one-dimensional version is expressed in dimensionless units. With a large variety of initial boundary conditions, the solutions can be expressed in a general form. For certain times, the function tends to approach a steady state regime, which may be of periodic character. The former time is also the characteristic time scale for transport of the minor component from a source at $z=0$ to high altitudes. For both hydrogen and helium in the terrestrial atmosphere, this is in the order of one day. The simple equation is a most idealized description of diffusion in the atmosphere. Nonetheless, the coincidence of the time scales for vertical transport to the escape region and the periodic variation found there indicate that a realistic evaluation of the density profile of hydrogen or helium should at least take into account the diurnal variation of conditions in the ambient atmosphere. It casts some doubt on models of diurnal variation constructed as a superposition of aperiodic stationary density profiles. Author

N67-18056# Boeing Scientific Research Labs., Seattle, Wash.
ON THE EXPERIMENTAL DETERMINATION OF MICROSTATE DISTRIBUTIONS ASSOCIATED WITH GAS-SURFACE SCATTERING
J. D. McClure Oct. 1966 24 p refs *Its* Flight Sci. Lab. Rept.-109 (DI-820569)

A method for determining velocity distributions in surface-scattered molecular beams is described. Time-of-flight effects in the modulated beams provide the means for extracting the velocity distributions from measured waveforms in the number density. A generalization of the method, applicable to the investigation of velocity-residence time distributions, is proposed for interactions in which the surface residence times are of the order of the molecular flight times. A system of 'broad-band' lock-in beam detection, useful for signal-to-noise enhancement, is also described. For demonstrative purposes, the method is used to examine collisional effects in direct beams generated with an array of capillary tubes. Evidence is found that the observed collisional reductions in beam intensity are associated with both internal scattering inside the capillary tubes and self-collision in the highly directional post-array density field. Author

N67-18058* Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics and Engineering Sciences.
RAY REFLECTION FROM ROUGH DIELECTRIC SURFACES
H. F. Nelson Nov. 1966 149 p refs
(AA&ES-66-5) CSCL 20N

A model for reflection of radiation from a periodic surface is developed using ray theory. This model contains both direct reflection from the surface and emerging radiation after internal scattering. It is shown that the surface reflection is a strong function of the A/A ratio, where A is the surface wavelength and A is its amplitude. For A/A approaching infinity, the periodic surface approaches a flat surface and the reflected radiation is very close to specular. As A/A decreases, multiple reflections begin to modify the reflected radiation distribution. For a full angle of incidence, this distortion is symmetrical. For large angles of incidence certain regions of the surface become shaded, highly distorting the reflected angular distribution. It is shown that reflection involving prior surface penetration followed by internal scattering emerges in a pattern very close to Lambert's Law, and its magnitude depends upon the index of refraction. The model is also extended to a random surface. Author

N67-18092* Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics and Engineering Sciences.
STUDY OF RECIRCULATING GAS FLOW FIELDS IN THE BASE REGION OF SATURN-CLASS VEHICLES Quarterly Progress Report, 1 May-31 Jul. 1966
Richard F. Hoglund 31 Jul. 1966 13 p refs
(Contract NAS8-11485)
(NASA-CR-81748) CFSTI: $3.00 CSCL 20D

Mathematical expressions for absorption and transmittance are developed to clarify the fundamental statistical basis for gas band models. The statistical model of a band assumes that the position and intensity of a given spectral line can be specified only by probability functions. It is assumed in the present statistical band models that the positions of the spectral lines occur at random within a given frequency interval and that there is no correlation between the positions of the various lines. The purpose of the work is to extend the validity of the models to a broader range of temperatures and pressures. L.S.

N67-18189# Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENTAL CHECK ON THE THEORETICAL RELATIONSHIP BETWEEN THE SPECTRAL DENSITY AND THE PROBABILITY DISTRIBUTION OF CROSSINGS FOR A STATIONARY RANDOM PROCESS WITH GAUSSIAN DISTRIBUTION, USING DATA OBTAINED IN MEASUREMENTS OF AIRCRAFT RESPONSE TO TURBULENT AIR
J. Burnham London, Min. of Aviation, Sep. 1963 18 p refs
(ARC-CP-834) HMSO: 4s

The theoretical relationship between the spectral density function and the probability distribution of crossings for a stationary random function with gaussian distribution has been used to calculate these distributions from spectra measured experimentally. The distributions so obtained are shown to compare well with distributions measured directly from the experimental data, the measured distributions being approximately gaussian and the experimental data behaving approximately in the manner of a stationary random process. Author

N67-18197*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENUMERATING NEIGHBORS IN DIAMOND-LIKE LATTICES
A. V. M. Ferris-Prabhu [1965] 14 p ref Submitted for Publication
(NASA-TM-X-57067) CFSTI: HC $3.00/MF $0.65 CSCL 20B

A method is demonstrated for locating sites in diamond-like lattices, and for obtaining the number and locations of their neighbors of arbitrary order. To enumerate and locate neighbors, shells of increasing radius are constructed and the number of lattice points lying on them are counted. Several illustrations are included which clarify the lattice structure relationships. A.G.O.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-18834# Polytechnic Inst. of Brooklyn, N. Y.
COLLISION STUDIES WITH HIGH ENERGY BEAMS
N. C. Peterson and E. Fonder *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 58-59 *ref* (See N67-18824 07-25)

Experimental work involving neutral atoms and ions having energies of 0.2 to 2 KeV from gaseous atoms and molecules is reported in progress. This work has as its objective the

determination of potential energies associated with repulsive interactions of pairs of atoms or molecules from experimentally measured scattering cross sections. Continuing investigation and fabrication of parts for a scattering apparatus and a neutral beam detector are mentioned. C.T.C.

N67-16835# Polytechnic Inst. of Brooklyn, N. Y.
RAY OPTICS FOR RADIATION PROBLEMS IN ANISOTROPIC REGIONS WITH BOUNDARIES LINE SOURCE EXCITATION, PART II
L. B. Felsen and S. Rosenbaum *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 62–85 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65
(Contract AF 19(628)-2357)

A class of problems involving a phased line distribution of electric and (or) magnetic currents in the presence of an anisotropic half space is considered, with no restrictions (except that of losslessness) placed on the anisotropy. Typical integrals descriptive of the field solution are formulated and evaluated by asymptotic techniques. The resulting saddle point and branch point contributions to the radiation field are interpreted in terms of ray optics, and it is shown that the former yields the direct, reflected, and refracted field whereas the latter furnishes a diffracted field in the form of a lateral wave. It is demonstrated that the ray-optical solution can be constructed without the intervention of the integral representation, and that its physical attributes suggest the possibility of generalizing the results to other configurations which are not readily susceptible to rigorous analysis. It is emphasized that the directly constructed ray-optical formulas are at least as good as the asymptotic approximation for the radiation field obtained by conventional asymptotic treatment of the radiation integrals. C.T.C.

N67-16946# Air Force Cambridge Research Labs., Bedford, Mass.
A NEW TECHNIQUE WHICH DIRECTLY DETERMINES MOLECULAR-VIBRATIONAL TRANSITION PROBABILITIES
Alva T. Stair, Jr. and Marshall H. Bruce *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 24 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

A technique is developed for empirically obtaining the vibrational matrix elements of simple molecules. The approach is to obtain the infrared spectra of molecules excited to high vibrational states by either chemiluminescence or vibraluminescence. The gas kinetic conditions are controlled to produce a Boltzmann distribution of vibrational states with high temperatures. The spectrum of a sequence is shown to be describable as a series of overlapping bands displaced by $2\cdot\Delta v\cdot\omega_e x_e$ in some cases. The magnitude of each band is proportional to the vibrational transition probability and the population in the upper state or the Boltzmann factor, $N(v', T_v)$. Rotational and vibrational temperatures are determined and the magnitude of each band gives directly the transition probability. Vibrational matrix elements of the $\Delta v = 2$ sequence of CO are determined from low resolution spectra by successively subtracting the contribution of each band. Transitions up to 17–15 are observed. Author

N67-16947# Aerospace Research Labs., Wright-Patterson AFB, Ohio. General Physics Lab.
EXPERIMENTAL AND THEORETICAL F-VALUES FOR λ 3076 ZnI, λ 3261 CdI AND λ 2537 HgI
Thomas M. Bieniewski, Thomas K. Krueger, and Stanley J. Czyzak *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 19 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

For the three atomic transitions, λ 3076 ZnI, λ 3261 CdI, and λ 2537 HgI, theoretical oscillator strengths were calculated using wave functions obtained by the Hartree–Fock self-consistent field method with exchange. The oscillator strengths for the same three transitions were also measured experimentally by the method of total absorption. The importance of configuration interaction in the HFSCF calculated wave functions is inferred from the comparison between the theoretical and the experimental oscillator strengths. Author

N67-17014# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.
ON THE HYPERFINE INTERACTION AND ZEEMAN EFFECT IN ATOMIC HYDROGEN $1S_{1/2}$ AND $2P_{1/2}$ STATES
Jack Finkel 18 Jul. 1966 16 p ref
(NOLTR-66-47; AD-641167) CFSTI: HC $3.00/MF $0.65

The eigenvalues and eigenfunctions of atomic hydrogen in the 1S(1/2) and 2P(1/2) states in the presence of a d.c. magnetic field taking account of the hyperfine interactions are calculated using matrix methods. Author (TAB)

N67-17121# Oslo Univ., Blindern (Norway). Inst. of Physics.
HIGH ENERGY PHYSICS WITH EMPHASIS ON STRANGE PARTICLES Final Scientific Report
30 Sep. 1966 84 p refs
(Grant AF-EOAR-65-95)
(AFOSR-66-2606; AD-641991) CFSTI: HC $3.00/MF $0.65

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1. PRODUCTION OF LAMBDA HYPERONS IN K^- INTERACTIONS AT REST IN CF_3Br T. Buran, A. G. Frodesen, O. Skjeggestad, H. Tofte, and I. Vegge p 2–25 refs (See N67-16122 07-24)
2. IDENTIFICATION OF NON-MESIC HYPERNUCLEI A. G. Frodesen p 26–80 (See N67-17123 07-24)

N67-17122# Oslo Univ., Blindern (Norway). Inst. of Physics.
PRODUCTION OF Λ HYPERONS IN K^- INTERACTIONS AT REST IN CF_3Br
T. Buran, A. G. Frodesen, O. Skjeggestad, H. Tofte, and I. Vegge *In its* High Energy Phys. with Emphasis on Strange Particles 30 Sep. 1966 p 2–25 refs (See N67-17121 07-24) CFSTI: HC $3.00/MF $0.65

The Λ production in K^- interactions which are not associated with the emission of charged or neutral pions was emphasized. The momentum spectra of the Λ hyperons and protons as well as their angular distributions were measured. A sample of Λ producing K^- interactions emitting a π^+ meson, as well as a selected sample of events with a π^- meson of kinetic energy 110 MeV were also measured. The momentum spectra of the π^+ mesons and of the Λ hyperons were compared to theoretical spectra calculated by an optical model, and the distributions of the angles between the Λ hyperons and pions or protons were compared to productions of the model. It was felt the model accounts well for the momentum distribution of pions and Λ hyperons and can also explain the main features of the Λ momentum spectra from multi-nucleon K^- absorptions. It was concluded that the total rate of emission of Λ hyperons from K^- interactions at rest in CF_3Br is estimated to (60±3)%, and that the amplitude for direct production of Λ hyperons in K^- captures on pairs of protons is small, and consistent with zero. N.E.N.

N67-17123# Oslo Univ., Blindern (Norway). Inst. of Physics.
IDENTIFICATION OF NON-MESIC HYPERNUCLEI
A. G. Frodesen *In its* High Energy Phys. with Emphasis on Strange Particles 30 Sep. 1966 p 26–80 (See N67-17121 07-24) CFSTI: HC $3.00/MF $0.65

A previous analysis of the production and decay reactions was extended to include all non-mesic hypernuclei which could be attributed to K^- captures at rest on light emulsion nuclei (C,N,O,) and for which it was possible to measure all tracks with sufficient accuracy. The validity of the kinematic analysis procedure is discussed, and tables are presented on the characteristics of the decays. It was determined that: (1) The analysis of K^- captures with charged pions appears useful for hypernuclei identification. (2) The K^- captures without pions seem best interpreted when neutron energy is lower than 120 MeV. (3) The π^0 disintegrations are mostly recognized by the analysis. (4) The non-mesically decaying hypernuclei are only partly recognized by the kinematic analysis. (5) The joint analysis of production and decay vertices of the same events shows that a consistent and satisfactory description can be obtained. N.E.N.

N67-17127# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SECOND SYMPOSIUM ON THE STRUCTURE OF LOW-MEDIUM MASS NUCLEI Final Report
Paul Goldhammer and L. Worth Seagondollar, ed. 23 Apr. 1966 294 p refs Symp. held at Wright-Patterson AFB, Ohio, 21–23 Apr. 1966; Sponsored by ARL, Kansas Univ., and North Carolina State Univ.
(ARL-66-0221; AD-642049) CFSTI: HC $3.00/MF $0.65

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7. GENERAL PROPERTIES OF NUCLEAR EXCITATIONS J. B. French (Rochester Univ.) p 223–241 refs (See N67-17134 07-24)
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9. RESONANCE REACTIONS AND ISOSPIN P. M. Endt (Utrecht State Univ.) p 276–291 refs (See N67-17136 07-24)

N67-17128# Argonne National Lab., Ill.
SHELL MODEL STUDIES IN NUCLEAR STRUCTURE
R. D. Lawson *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 6–37 refs (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

The dilemma of the shell model is discussed in detail, i.e., although a large amount of experimental data can be fitted with a simple configuration, an increasing body of experimental data cannot be fitted by the same configuration. Model calculations, using oxygen isotopes, are given to illustrate that many nuclear properties are almost completely insensitive to large amounts of configuration mixing. The model used, which was exactly soluble, was solved and attempts were made to fit many of the results of the exact calculation making the usual shell model assumptions. It is pointed out that the fitting of a rather large body of experimental data with a simple configuration does not confirm the hypothesis that the assumed shell is fairly pure. The calculations indicated: (1) when a severely truncated Hilbert space is used, the concept of a bare particle should be replaced by the idea of a clothed nucleon and (2) in dealing with a truncated Hilbert space, one should not expect to get agreement with experiment using the free nucleon–nucleon interaction. L.E.W.

N67-17129# Kansas Univ., Lawrence.
SPIN ASSIGNMENTS FROM TRIPLE CORRELATION UTILIZING AXIAL SYMMETRY
F. W. Prosser, Jr. *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 38–76 refs (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

The use of axial symmetry in obtaining spin assignments from triple correlation is discussed in detail. The formulation of the relevant correlation expressions are presented, the experimental and analytical advantages are emphasized, and examples are given as illustrations. The major advantages pointed out include restriction on the number of nontrivial population parameters, independence of the formalism from any assumption about reaction mechanism, and detection of the radiation subsequent to bombardment of an unpolarized target with an incident unpolarized radiation with excellent resolution and efficiency, allowing a detailed study of the spins and gamma ray decay properties of desired states in the residual nucleus. The examples given include the $Mg^{26}(p,\alpha\gamma)Na^{23}$ reaction, the $Si^{28}(d,p\gamma)Si^{29}$ reaction, and results from heavy ion reactions with all participating nuclei even–even. L.E.W.

N67-17130# Toho Univ., Tokyo (Japan). Dept. of Physics.
sd-SHELL NUCLEI AND THE SHELL MODEL
Akito Arima *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 77–103 refs (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

In relation to shell model calculations of sd-shell nuclei, consideration is given to binding energy and coupling schemes; the role of symmetry; two, three, or four body problems with central interaction only; the spectroscopic factor; and the effect of non-central interactions. Investigations of the giant resonance of C^{12} are summarized, and the following characteristics are discussed: (1) The energy of the main peak in the reaction $B^{11}(p,\gamma_1)C^{12*}$ is higher by about 3 or 4 MeV than that in the reaction $B^{11}(p,\gamma_0)C^{12}$. (2) The giant resonance based on the excited state has a broader width than that based on the ground state. (3) There are correlations between some of the peaks in the excitation functions of the two kinds of reactions. (4) The former peak (25.5 MeV) of the reaction $B^{11}(p,\gamma_0)C^{12}$ cannot be expected in previous studies. The meaning of the four characteristics is interpreted by a simple phonon picture. It is pointed out that the details of the fine structures summarized in the characteristics can be reproduced by taking into account the coupling of the dipole states with the quadrupole vibration. L.E.W.

N67-17131# Glasgow Univ. (Scotland). Dept. of Natural Philosophy.
INVESTIGATION OF Al^{27}, P^{31} AND S^{32} BY ELECTRON SCATTERING
G. R. Bishop *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 104–128 refs (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

The study of the structure of p-shell nuclei through the scattering of high energy electrons is reviewed, and the extension of the analysis to experiments on nuclei in the 2s to 1d shells by minor modifications is discussed. The experimental apparatus and

procedures used are described, and the problems of wave distortion and radiative corrections are considered. It was felt that a sufficient number of known radiative widths were reproduced by analyzing the experiments to indicate previously unknown transitions. Electrons of energies between 80 and 200 MeV were scattered from metallic Al^{27} and measured at angles between 45° and 135°. The results of phase shift calculations of elastic form factors were compared with selected experimental data. Interpretation of the Al^{27} data indicated that although the E2 transition probabilities seem consistent with the model, the M1 transitions cannot be made internally consistent. Comments are also included on previous studies on P^{31} and S^{32}. L.E.W.

N67-17132# Universidad Nacional Autonoma de Mexico, Villa Obregon. Inst. de Fisica.

GROUP THEORY AND NUCLEAR STRUCTURE IN THE 2s–1d SHELL

M. Mosinsky, M. Berrondo, and J. Pineda *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 129–194 refs Prepared jointly with Comision Nacional de Energia Nucl., Mex. (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

A technique is described which is the systematic use of group theory methods to characterize and solve the problems involved in studying the nuclei. The group theory method is described with respect to (1) many-body problem of n fermions being acted upon by one-body operators and two-body operators, (2) the states in the 2s–1d shell, in which the orbital part of the single particle states is restricted to the 2s–1d shell in a common potential, taken in the harmonic oscillator form, and (3) the model interaction, both pairing and quadrupole–quadrupole. The subalgebra matrix classification of states is considered for the explicit construction of states, matrix elements, and the irreducible tensor character of the spin–orbit coupling interaction. The j-j coupling states and particle hole states are also mentioned. N.E.N.

N67-17133# Argonne National Lab., Ill.

THE GIANT DIPOLE RESONANCE IN LIGHT NUCLEI

L. Meyer-Schuetzmeister *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 195–222 refs Supported by AEC (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

Details are presented on the variations of the electric dipole resonance, obtained by studies of photonuclear reactions, inelastic electron scattering, and proton capture. The integrated cross sections for particle emission on the shapes of the giant resonance are compared for the nuclei C^{12}, O^{16}, Ne^{20}, Si^{28}, and Ca^{40}. The cross sections, integrated over the giant dipole resonance, are for total neutron emission, total proton emission, and proton emission leading exclusively to the ground state of the final nucleus. Graphs of cross sections as a function of the excitation energy are presented, and data from alpha capture studies are mentioned. N.E.N.

N67-17134# Rochester Univ., N. Y.

GENERAL PROPERTIES OF NUCLEAR EXCITATIONS

J. B. French *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 223–241 refs Supported by AEC (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

The averaged properties of energy spectra and excitation spectral distributions are discussed. The energy spectra are considered for the interaction of an active particle with the closed-shells. Scalar distribution decomposed into a set of fixed-partition scalar distribution is described. Nonscalar distributions, and extensions and applications of spectral distributions are mentioned. The excitation spectral distributions are discussed from the standpoint of strength moments. The way in which the strength divides among the final states of different isospin and angular momentum is also considered. It is suggested that the averaged distribution moment method of treating nuclear excitations may be superior to older methods in many cases. N.E.N.

N67-17135# California Inst. of Tech., Pasadena.

NUCLEAR REACTIONS IN ASTROPHYSICS

C. A. Barnes *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 242–275 refs (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

(Contract Nonr-220(47); Grant NSF GP-5391)

Nuclear reactions of light and middle weight elements involved in stellar evolution are discussed; and some illustrations depict the Andromeda galaxy, and the nebula in Sagittarius, Lyra, and Taurus. Processes involved in nuclear synthesis are considered, and the relative abundance of nuclear species are plotted on the basis of meteoritic and solar spectrum data. Hydrogen and helium burning are discussed in relation to the development of stats, as are the s-, r-, α-, and e-processes. The final evolution in the evolution of the described 30-solar mass star is triggered by the exhaustion of the nuclear fuel in the core because of the iron group nuclei buildup. Further core contraction makes temperature rise, and some of the iron- peak nuclei and other nuclides photodisintegrate rapidly; and this leads to collapse of the core until it is in free fall. Dynamical behavior of the star depends on its mass and previous history, and at least the central regions of the core implode. The outer regions still possess nuclear energy resources. M.W.R.

N67-17136# Utrecht State Univ. (Netherlands). Physics Lab.

RESONANCE REACTIONS AND ISOSPIN

P. M. Endt *In* ARL 2d Symp. on the Struct. of Low-Medium Mass Nuclei 23 Apr. 1966 p 276–291 refs (See N67-17127 07-24) CFSTI: HC $3.00/MF $0.65

In order to consider the group of resonances with isospin T + 1 in a nucleus with ground-state isospin T, subgroup resonances are selected of which each is the analog of a low-lying bound state with reasonable single particle character in the isobaric nucleus with ground-state isospin T + 1. These resonances have a large reduced proton width, a large gamma width, and simple decay gamma decay to a single lower state. Accurate p,γ-reaction yield measurements are considered in relation to resonance strengths; as the resonance parameters of spins, parities, and proton widths are discussed. Attention is given to various twin resonances, and to Ar^{38} and Ar^{36} level schemes for which many odd parity states are known. Gamma decay is plotted for these two levels. M.W.R.

N67-17139# Authority Health and Safety Branch, United Kingdom Atomic Energy Authority, London (England).

PHOTON INTERACTION DATA IN THE U.K.A.E.A. NUCLEAR DATA LIBRARY

P. J. Hemmings and Susan M. Offord 1966 48 p refs (AHSB(S)-R-109) CFSTI: HC $3.00/MF $0.65

Photon interaction data for 25 elements and water were collected. The methods of photon interaction are discussed with reference to transmission calculations. Tabulations are given of cross sections for each element, and the angular distribution for Compton scattering is given at 23 energies. The energy range considered is 0.01 to 20 MeV. Author

N67-17160# Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina). Laboratorio de Radiaciones y Alta Atmosfera.

QUEERNESSES IN THE DEFORMATION CHART Interim Report, 15 Mar. 1966–15 Mar. 1967

C. A. Heras (Oriente Univ.), S. M. Abecasis, and H. E. Bosch Jul. 1966 27 p refs
(Grant DA-ARO-49-092-66-G121)
(LR-13; AD-641463) CFSTI: HC $3.00/MF $0.65

The structure of the excited levels in some neutron-deficient barium isotopes is described. A comparison between the results experimentally obtained by different authors and those theoretically predicted by several nuclear models is performed. The character of the collective transitional region to which belong these nucleides is thoroughly discussed, relation is made with the competition between spherical and deformed shapes in different regions of the deformation chart. Author (TAB)

N67-17199# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
CONSISTENCY OF CURRENT COMMUTATORS
Irwin Goldberg and Egon Mark [1966] 15 p refs Prepared Jointly with Clarkson Coll. of Tech., Potsdam, N. Y. Revised
(AD-640153) CFSTI: HC $3.00/MF $0.65

An apparent paradox is presented that originates from current commutators in quantum electrodynamics, followed by its solution. In the two appendices the author discusses the presentation made of the same (or a closely related) paradox by Schwinger in 1959 and Johnson in 1961. The conclusion is that there is no need to modify the current commutators. Author (TAB)

N67-17201# Israel Program for Scientific Translations, Ltd., Jerusalem.
CONTRIBUTIONS TO THE THEORY OF WEAK AND STRONG INTERACTIONS OF ELEMENTARY PARTICLES
V. B. Berestetskii, ed. 1965 191 p refs Transl. into ENGLISH of the book "Voprosy Teorii Sil'nykh i Slabykh Vzaimodeistvii Elementarnykh Chastits" Erevan, Izd. AN Arm. SSR, 1962 Lectures read at Spring School of Theoret. and Exptl. Phys., Nor-Amberd, USSR, 3–14 Apr. 1961 Published for AEC and NSF
(AEC-TR-6632) CFSTI: HC $3.00/MF $0.65

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15. THE SIGN OF THE K_1^0–K_2^0 MASS DIFFERENCE S. G. Matinyan p 167–170 refs (See N67-17216 07-24)

N67-17202# Israel Program for Scientific Translations, Ltd., Jerusalem.
APPLICATION OF DISPERSION RELATIONS IN THE NONRELATIVISTIC REGION
A. B. Migdal *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 1–5 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

A causality condition is set for the physical conditions that lead to the dispersion relations in the nonrelativistic region, and the Fourier representation of the displacement is considered to determine the permittivity or polarization. Because of the causality condition, the permittivity is a real-valued function in the upper-half of the ω-plane. The Cauchy theorem is applied in the determination of the integration contour. Scattering of light by a charged system is treated, but it is noted that the same representation is erroneous since the scattering amplitude at high frequencies approaches the sum of the Compton scattering amplitudes for the free charges rather than zero. A different form is, therefore, given for the subtracted dispersion relation for the zero-angle forward scattering. The dipole approximation permits the scattering amplitude to be found at any angle; and the nuclear coherent scattering cross section for light can be determined from the observed cross section. M.W.R.

N67-17203# Israel Program for Scientific Translations, Ltd., Jerusalem.
GENERAL METHOD FOR CONSTRUCTION OF THE SCATTERING MATRIX
B. L. Ioffe *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 6–22 refs (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

Scattering matrixes are constructed in simple nonrelativistic quantum mechanics and in quantum field theory. For the latter, a neutral scalar boson field is considered; and the scattering problem is based on Lorentz invariance, invariance under displacement in Minkowski space, a causality condition, and an asymptotic condition. Invariance under various transformations in the scheme of the scattering matrix is treated. These transformations are studied as space reflection, charge conjugate, and time reversal. M.W.R.

N67-17204# Israel Program for Scientific Translations, Ltd., Jerusalem.
ONE-DIMENSIONAL DISPERSION RELATIONS FOR THE SCATTERING AMPLITUDE
B. L. Ioffe *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 23–34 refs (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

A retarded commutator and a four-dimensional delta-function are obtained in order to study the dispersion relations in meson-nucleon scattering amplitude. Breit coordinates are then used to express the total meson energy and the momentum transfer in the scattering amplitude. Both one- and two-particle states are

treated. In considering the case of forward scattering, it is shown that the dispersive and absorptive functions are the real and imaginary parts, respectively, of the scattering amplitude. Attention is given to the spin-structure of the scattering amplitude. M.W.R.

N67-17205# Israel Program for Scientific Translations, Ltd., Jerusalem.

INTRODUCTION TO S-MATRIX THEORY BASED ON ANALYTICITY AND UNITARITY PROPERTIES

V. B. Berestetskii *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 35–51 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

A dispersion relation approach is taken to the structure of elementary particles and their interactions. The scattering matrix is discussed; and an expression for scattering amplitude is given by a Born approximation in the center-of-mass system. The relativistic counterparts are determined for this approximation; and some applications of the resulting expression are included that deal with particle decay, collision of two particles, and photoproduction of pions on nucleons. The unitarity relation or condition is treated as the next important property of the S-matrix; and simple applications of unitarity and analyticity are presented. It is shown that the lower limit of the dispersion integral for the form-factor determines the effective spatial extension of a particle. In the normal case, the radius of the particle is determined by the minimum mass of the possible product particles; in the anomalous case, the particle radius can be much larger. M.W.R.

N67-17206# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE ANALYTICAL PROPERTIES OF THE SIMPLEST FEYNMAN DIAGRAMS

V. N. Gribov *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 52–61 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

Consideration is given to a Feynman diagram that depends essentially on the energy of the system and the transferred momentum. The squares of the external momenta represent the squares of the masses of the scattered particles; and, according to the definition of Feynman integrals, the squares of the masses have a negative imaginary part. Expressions are given for the determination of the singularities, for which the Landau condition is sufficient. When the masses reach the decay limit, the curves cease to be singular; the singularities move to the complex region and the Landau method is no longer applicable. For such physical problems, the analytical properties of the scattering amplitude must be known; and the square graph, which has a double spectral representation for normal mass relations, is used. M.W.R.

N67-17207# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE MANDELSTAM REPRESENTATION

K. A. Ter-Martirosyan *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 62–73 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

It is shown that the double representation for the amplitude of a tetrode, according to Mandelstam, follows from one-dimensional dispersion relations; and that the two-particle term in the unitarity condition can be reduced to the one-dimensional form. Multi-particle terms are taken into account, as is the possibility of the convergence of integrals. M.W.R.

N67-17208# Israel Program for Scientific Translations, Ltd., Jerusalem.

INTEGRAL EQUATIONS FOLLOWING FROM ANALYTICITY AND UNITARITY

K. A. Ter-Martirosyan *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 74–99 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

A system of relativistically invariant amplitudes is considered; and equations expressing the unitarity condition are given. Static nucleon and scalar mesons are discussed for a semirelativistic model, and various integral equations are evolved. A system of equations for the amplitudes is also given that takes in all the possible physical states, and that applies to any complex values of energy. A discussion of relativistic theory is concerned with particles of spin zero; and the scattering amplitude of these particles is written in the Mandelstam representation. Unitarity conditions are derived; as are two pairs of analogous equalities from some of these unitarity relations. A complete system of equations is presented, and an appendix deals with the theory of transitions in the continuous spectrum. M.W.R.

N67-17209# Israel Program for Scientific Translations, Ltd., Jerusalem.

ASYMPTOTIC BEHAVIOR OF CROSS SECTIONS AT HIGH ENERGIES

V. N. Gribov *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 100–106 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

A quasiclassical model is considered in the study of the asymptotic behavior of cross sections obtained during high energy interactions of pions with nucleons. Spin and isotopic variables are neglected because they have little effect on the results. The asymptotic behavior of the interaction is substantiated by using the analytical properties of the scattering amplitude. It is assumed that one analytical function serves both the direct and crossed reactions. Consideration is also given to the assumption that the same function also determines the amplitude of the reactions. M.W.R.

N67-17210# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXTRAPOLATION OF THE π–N AMPLITUDE INTO THE NONPHYSICAL REGION USING DISPERSION RELATIONS AND UNITARITY CONDITION

A. F. Grashin *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 107–121 refs (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

A scheme is considered for calculating the π–N amplitude that results in simple analytical expressions for such invariant amplitudes. The unitarity condition is assumed for only the annihilation channel, and the imaginary part of the scattering amplitude for the scattering channel is regarded as an experimentally known function. Equations are evolved for invariant amplitudes, and solutions for these equations begin with their expansion in terms of annihilation amplitude components. A pion form-factor is introduced, and its asymptotic behavior is assumed. The calculation of inhomogeneous terms in the equations is considered. These terms contain subtraction terms and integrals over the imaginary parts of the invariant amplitudes. M.W.R.

N67-17211# Israel Program for Scientific Translations, Ltd., Jerusalem.

THEORY OF REACTIONS WITH THREE-PARTICLE PRODUCTION NEAR THE τ-DECAY THRESHOLD

V. N. Gribov *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 122–134 refs (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

For any reaction with three-particle production, the contribution of the interaction over large distances can be isolated in

energy-linear terms. This contribution is proportional to the amplitudes of pair interactions and is not expandable in above-threshold momenta. Several methods are proposed for determining the scattering amplitudes of unstable particles at zero energy by analyzing the reactions in which they are formed. The energy distribution of the produced particles essentially depends upon the scattering amplitude of the particle pairs; and these amplitudes can be determined from the momentum distribution at production. Three-particle singularity is considered in detail, and various scattering reactions are treated. M.W.R.

N67-17212# Israel Program for Scientific Translations, Ltd., Jerusalem.

APPLICATION OF DISPERSION RELATIONS TO THE MANY-BODY PROBLEM

A. B. Migdal *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 135–139 refs (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

Analytical properties of a one-particle Green function are examined in relation to the application of dispersion relations to the many-body problem. Fourier transform is given, and the operators are written in terms of energy. This is followed by Lehmann's form for the one-particle Green function; and the Cauchy integral that defines the two analytical functions, one on either side of a contour. A representation is shown for the complex conjugate of the Green function, as are graphs of Dyson's equations for the Green function. The possibility of extracting definite information by means of the dispersion technique is shown for cases where the actual interaction is not considered. M.W.R.

N67-17213# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE SAKATA MODEL

L. B. Okun' *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 140–148 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

Classification of elementary particles, most of which are strongly interacting, are discussed for various compound models. Emphasis is placed on the Sakata model, which assumes that all particles have three fundamental parts and their antiparticles; and by postulating a strong attraction between particles and antiparticles, it is possible to determine all of the other particles. The Sakata model assumes that no multiply charged particles exist, since protons repel one another in all states. The strangeness of any particle is specified by the number of Λ's in it; and the interaction of these particles is assumed to be weaker than nucleon interactions. Two isoscalar particles are predicted by the Sakata model, which sheds light on the spin and parity of elementary particles. In addition to the stable particles, the model indicates a large number of unstable ones that may be manifested as resonances. There are indications for the existence of excited hyperons, for example. The Klev symmetry is mentioned, as are weak interactions, one or two neutrons, the intermediate mesons, and isotopic selection rules. M.W.R.

N67-17214# Israel Program for Scientific Translations, Ltd., Jerusalem.

EFFECTS ASSOCIATED WITH CAPTURE OF NEGATIVE MUONS

S. S. Gershtein *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 149–156 (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

Changes that are brought about during strong interactions are discussed, as are the effects associated with the capture of negative muons. A Lagrangian is used to describe the muon capture, the matrix element is obtained, and the form factors are expressed in terms of electromagnetic neutrons and protons by applying the vector current conservation hypothesis. Muon capture constants are related to muon decay constants. Experimental results are noted with muon capture by protons, capture probability for various ions, parity nonconservation, and polarization retained by muons. The capture of polarized muons should result in an angular asymmetry in the distribution of neutrons around in the direction of muon spin; and muon capture studies may permit the experimental determination of the helicity of the muon neutrino. M.W.R.

N67-17215# Israel Program for Scientific Translations, Ltd., Jerusalem.

NEUTRAL KAONS

I. Yu. Kobzarev *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 157–166 refs (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

Kaons K^0 and $\bar{K}^0$ appear to have different strangeness; and because they are weakly interacting, can be converted to one another. Since the former does not have a definite combined parity, neither kaon can by itself decay into pions in a definite state; but linear combinations of the two kaons that have a definite combined parity can be formed. The existence of different decay channels for K_1^0 and K_2^0 (which decay into two and three pions, respectively) results is a measurable mass difference between the two. By measuring the baryon recoil momenta, which differ for the creation of the two kaons, it is possible to determine which of the kaons has been created. Various other experiments with neutral kaons are described, including those dealing with scattering, transitions, and parity changing. M.W.R.

N67-17216# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE SIGN OF THE K_1–K_2 MASS DIFFERENCE

S. G. Matinyan *In its* Contrib. to the Theory of Weak and Strong Interactions of Elementary Particles 1965 p 167–170 refs (See N67-17201 07-24) CFSTI: HC $3.00/MF $0.65

Experimental means are considered for determining the sign of the mass difference between two kaons (K_1^0–K_2^0). The use of one or more very thin plates is studied; and results with an optical model of the nucleus yield a $\phi \approx 30°$ with a positive sign. Equations are then given to show the change of amplitude due to decay, the change of phase, and differences between the strong interactions of the kaons. M.W.R.

N67-17238# Naval Radiological Defense Lab., San Francisco, Calif.

ANGULAR DISTRIBUTIONS AND ENERGY SPECTRA OF ELECTRONC TRANSMITTED THROUGH AND REFLECTED FROM ELEMENTAL FOILS

Bruce W. Shumway, William E. Kreger, and Ralph M. Brown 8 Sep. 1966 44 p refs

(USNRDL-TR-1069; AD-640865) CFSTI: HC $3.00/MF $0.65

Experimental electron energy spectra at various angles of emergence or reflection from foils of carbon, aluminum, copper, silver, and gold were measured. Thicknesses used ranged from 0.2 to 0.6 of the electron range. In all cases the incident radiation was a broad, monodirectional, monenergetic electron beam perpendicular to the foil. Beam energies were 0.5, 0.75, 1.0, 1.5, and 1.95 MeV. The spectrometer used as anthracene crystal as the detector. Author (TAB)

N67-17249# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

CURRENT COMMUTATORS IN QUANTUM ELECTRODYNAMIC

Irwin Goldberg [1965] 3 p refs Prepared in cooperation with Clarkson Coll. of Technol.
(AD-640152) CFSTI: HC $3.00/MF $0.65

The commutator $(j_0(y),j_\mu(x))_{x_0} = 0$ is considered in a discussion on current commutators in quantum electrodynamics. Arguments are presented against the fact that the commutator does not lead to inconsistencies for either the free fields or for those theories in which an interaction representation is possible. The purpose of the discussion is to generalize the result and provide a simple proof of consistency for all cases. S.P.

N67-17264 Chicago Univ., Ill. Inst. for Computer Research.
μ-CAPTURE PROGRAM
K. Laitinen, N. Alton, and J. Klems *In its* ICR Quart. Rept., No. 9 1 May 1966 7 p (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

A program to process data gathered from studies of the basic μ-capture process is developed. Cameras were used to photograph the reaction of an ≈ 991/2% pure muon beam from the cyclotron brought to rest in an 8-liter hydrogen bubble chamber. The reaction is identified by appearance of a recoil proton created by the neutron and by absence of a decay electron. Resulting photographs are scanned manually and points selected from each view are digitized and punched onto paper tape with the information from related views making up one frame of data. The paper tape data is then transferred to magnetic tape and used as input data to the program. S.P.

N67-17265 Chicago Univ., Ill. Inst. for Computer Research.
HIGH-ENERGY INTER-NUCLEAR CASCADES
A. Van Ginneken et al *In its* ICR Quart. Rept., No. 9 1 May 1966 1 p refs (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

Development of internuclear cascades induced by high-energy (0.1–3.0 Gev) particles in large targets of complex nuclei was studied by a Monte Carlo calculation using Meniac III and by radiochemical experiments. The particles considered in the calculation were fast nucleons and charged pions emitted in the inelastic particle–nucleus interactions. S.P.

N67-17337 Polish Academy of Sciences. Warsaw. Inst. of Nuclear Research.
INVESTIGATION OF THE DECAY SCHEME OF Ne^{23} AND INTERPRETATION OF THE EXPERIMENTAL RESULTS ON THE BASIS OF THE COLLECTIVE MODEL INCLUDING ROTATION–PARTICLE COUPLING [BADANIE SCHEMATU ROZPADU Ne^{23} I INTERPRETACJA UZYSKANYCH REZULTATOW NA GRUNCIE MODELU KOLEKTYWNEGO Z UWZGLEDNIENIEM SIL CORIOLISA]
Henryk Lancman (Ph.D. Thesis) 1965 101 p refs In POLISH; ENGLISH summary
(INR-627/IA/PL) CFSTI: HC $3.00

The decay scheme of Ne^{23} has been investigated with a conventional fast slow coincidence spectrometer. The isotope Ne^{23} was obtained by irradiation of spectrally pure neon with thermal neutrons in a reactor. A loop designed specially for activation of gases was used for this purpose. New β-transitions to four excited states in Na^{23} /2405 keV, 2705 keV, 2870 keV and 2990 keV/ were found and the corresponding log ft values were established. Two new excited states in Na^{23} /2405 keV and 2870 keV/ were found and their possible spins and parities determined. The spin of the 2705 keV state was found to be 7/2. The lifetime of the first excited state of Na^{23} was measured by means of the resonant scattering method. The relative intensities of the γ-transitions were determined. The decay scheme of Ne^{23} is proposed. Author

N67-17354# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
COMPUTER PROGRAM FOR THE CONSTRUCTION OF TABLES OF GAMMA PEAKS AND FOR CALCULATION OF SPECIFIC ACTIVITIES OF RADIOISOTOPES FORMED BY (n,γ) REACTION
G. Guzzi, J. Pauly, F. Girardi, and B. Dorpema Brussels, EURATOM, Oct. 1966 67 p refs
(EUR-3154.E) CFSTI: $3.00

A computer program called LIBRAR has been developed in order to derive tables of gamma peaks classified according to their energy and to calculate the specific activities of peaks from radioisotopes produced by (n,γ) reactions. Photoelectric peaks and double escape peaks were considered. The input data include the efficiency curves of the detector, cross-sections and gamma ray abundances of the isotopes considered: for these last quantities either literature data or values determined experimentally in this laboratory have been used. The list of the program and an example of the input data are given in appendices. Author

N67-17401# California Univ., Berkeley. Lawrence Radiation Lab.
^{37}Ca AND THE MASS 37 T=3/2 QUAPTET
J. Cerny, S. W. Cosper, R. L. McGrath, and G. W. Butler Jul. 1966 9 p refs Presented at Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn.
(Contract W-7405-ENG-48)
(UCRL-16990; CONF-660906-32) CFSTI: HC $3.00/MF $0.65

The mass 37 isospin quartet was completely determined, thus furnishing another test of the isobaric multiplet mass equation. A three-counter-telescope, particle-identification system determined the ^{37}Ca mass excess via the $^{40}Ca(^3He,^6He)^{37}Ca$ reaction. The lowest T=3/2 states of ^{37}Ar and ^{37}K were located through the $^{39}K(p,\ ^3He)^{37}Ar^*$ and $^{39}K(p,t)^{37}K^*$ reactions. Author (NSA)

N67-17408# Oak Ridge National Lab., Tenn.
TRANSITION RADIATION AND LOW-ENERGY BREMSSTRAHLUNG FROM SILVER AND ALUMINUM FOILS BOMBARDED BY GRAZING-INCIDENCE ELECTRONS
Leighton Scott Cram (M.S. Thesis—Vanderbilt Univ.), E. T. Arakawa, G. E. Jones, and R. D. Birkhoff Sep. 1966 78 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1571) CFSTI: HC $3.00/MF $0.65

The visible and ultraviolet light emitted by silver and aluminum foils bombarded by high energy electrons was investigated experimentally. The absolute photon intensity was measured and its dependence upon angle of electron incidence, wavelength, electron energy, and foil thickness was determined. The spectral distribution of this radiation was studied specifically for grazing incidence electrons on these metals. Results were compared with theoretical calculations of bremsstrahlung and transition radiation. The optical emission spectra of silver and aluminum foils showed greatly enhanced emission upon bombardment by grazing incidence electrons as compared to normal incidence electrons. Spectra observed from thick silver films evaporated onto tantalum backings were inconclusive in that results could not be verified as due to plasma radiation, transition radiation, and/or bremsstrahlung. NSA

N67-17409# California Univ., Berkeley. Lawrence Radiation Lab.
MULTI-PION FINAL STATES FROM π^-p INTERACTIONS AT 3.2 AND 4.2 BeV/c
Suh Urk Chung (Ph.D. Thesis) 8 Jul. 1966 240 p refs
(Contract W-7405-ENG-48)
(UCRL-16881) CFSTI: HC $3.00/MF $0.65

An analysis was made of approximately 30,000 four-prong events at π^- beam moments of 3.2 and 4.2 BeV/c, obtained with

the 72-inch hydrogen bubble chamber at the Lawrence Radiation Laboratory. All the effective-mass distributions obtainable from the final states $p\pi^+\pi^-\pi^-$, $p\pi^+\pi^0\pi^-\pi^-$, and $n\pi^+\pi^+\pi^-\pi^-$, as well as the cross sections of these final states are presented. In addition, the results of a study of the quasi-three-body final states N^{*++} (1238) $\pi^-\pi^-$, $p\pi^-\rho^0$, $p\pi^-\omega$, and $p\pi^-\eta$ are presented. Particular emphasis was given to the production and decay of the A_1, A_2, and B enhancements; the A_1 and B enhancements observed in the data are consistent with the interpretations as kinematic enhancements, and the A_2 enhancement can be interpreted only as a genuine resonant state. From the study of the decay angular correlations in the A_2 region as well as the control regions, it was determined that the lowest possible quantum numbers of the A_2 are $J^P=2^+$. Author (NSA)

N67-17413# Los Alamos Scientific Corp., N. Mex.
ENERGY DEPENDENCE OF ANGULAR DISTRIBUTION OF FRAGMENTS IN THE FISSION OF ^{233}U, ^{235}U, AND ^{239}Pu INDUCED BY NEUTRONS
V. G. Nesterov, G. N. Smirenkin, and D. L. Shlak [1966] 27 p refs Transl. into ENGLISH of Russian Rept. FEI-33
(LA-TR-66-41) CFSTI: HC $3.00/MF $0.65

The results of an investigation of the fission-fragment angular distributions in the neutron fission of ^{239}Pu, ^{233}U, and ^{235}U are presented. Measurements were made for ^{239}Pu and ^{233}U in the range of neutron energies from 0.08 to 1.5 MeV, while for ^{235}U the energy range was extended up to 6 MeV. The fragments were recorded using an electronic circuit that permitted the simultaneous counting of pulses from six ionization counters. NSA

N67-17414# Institute for Mathematical Sciences, Madras (India).
SELECTED TOPICS IN WEAK INTERACTIONS
Ph. Meyer [1965] 82 p refs
(NP-16232; Rept.-48) Available from Inst. for Math. Sci., Madras: $1.00

Various aspects of the theory of weak interactions are discussed. The 11 lectures include such topics as the conserved vector current hypothesis, partially conserved axial vector current theory and Goldberger–Treiman relation, elastic and inelastic neutrino reactions, the intermediate vector boson, SU(3) symmetry for weak interactions, and the CERN neutrino experiment. NSA

N67-17415# European Atomic Energy Community, Brussels (Belgium). Radioisotopes Group.
PRACTICAL ASPECTS OF ACTIVATION ANALYSES WITH CHARGED PARTICLES
1966 185 p In FRENCH, ENGLISH and DUTCH Proc. of a Meeting at Grenoble, France, 23 Jun. 1965
(EUR-2957.d.f.e; CONF-650667)

Discussions on the chief practical problems encountered by specialists in charged-particle activation analysis are presented. NSA

N67-17416# Delhi Univ. (India). Dept. of Physics and Astrophysics.
LECTURES ON HIGHER SYMMETRIES OF HADRONS
B. Sakita (Argonne Natl. Lab.) 27 Jul. 1965 106 p refs Lectures presented at Summer School of Theoret. Phys., Dalhousie, India, 25 May–15 Jun. 1965
(NP-16191)

A series of lectures are presented on higher symmetries of elementary particles. Topics discussed are historical survey, SU_6 symmetry scheme, problems of relativization of SU_6, phenomenological approach to relativistic SU_6, and Lie group of strong coupling theory. NSA

N67-17417# Helsinki Univ. (Finland). Research Inst. for Theoretical Physics.
INTRODUCTORY LECTURES ON SU_3 SYMMETRY
Keijo Kajantie 1966 66 p refs Lectures presented at Helsinki, 1965
(NP-16242)

Five lectures are presented on SU(3) symmetry. Topics discussed are SU(2) symmetry, irreducible tensors, representations of SU(3) lie algebra A_2, experimental consequences of SU(3) symmetry, and broken symmetry. NSA

N67-17418# Max-Planck-Institut fuer Kernphysik, Heidelberg (West Germany).
[TANDEM ACCELERATORS, COSMOCHEMISTRY AND SPACE RESEARCH, CYCLOTRONS, AND NUCLEAR SPECTROSCOPY] Annual Report, 1964 [JAHRESBERICHT 1964]
W. Hering, comp. Feb. 1966 159 p refs In GERMAN
(BMWF-FB-K-66-01)

The studies made at the Max Planck Institute for Nuclear Physics in Heidelberg on tandem accelerators, cosmochemistry and space research, cyclotrons, and nuclear spectroscopy are summarized. Results were reported on studies of the $^4He(\alpha,\alpha)^4He$ reaction, $p+D \rightarrow p+p+n$, ^{14}N-induced nuclear reactions, statistical fluctuations in the cross sections of $^{26}Mg(p,p)$, $^{26}Mg(p,\alpha)$, $^{37}Cl(p,\alpha)$, $^{45}Sc(p,\alpha)^{42}Ca$, $^{56}Fe(p,p)(p,\alpha)$, and $^{54}Cr(p,p)$ and (p,α) reactions, isobaric analog states, stripping reactions producing ^{53}Cr, ^{55}Cr, ^{31}Si, ^{53}Mn, ^{51}Cr, ^{39}Ca, and ^{41}Sc subcoulomb stripping, high-resolution γ spectrometer, target chambers, isotope analysis and age determination of meteorites, diffusion of rare gases and tritium in meteorites, chemical distinction of the bright–dark structure of primordial rare-gas containing stone meteorites, rare gas isotopes of stone meteorites, K–Ar determination in iron meteorites, fission ^{40}Ar in iron meteorites, production of K and Ni and Fe targets by proton bombardment, isotopic frequency and concentration of Li in stone meteorites, detection of single ions in mass spectrometers, mineral existence of meteorites and cosmic spheroids, meteorite craters and tectite problem, age determinations and rare gas isotope measurements in terrestrial stones, collection and recording of cosmic dust, mass spectrometry of the outer atmosphere, registration of cosmic radiation, radioactive aerosols of the atomsphere, elastic and inelastic scattering of deuterons, (d,α) reactions on light nuclei, (d,n) reactions and total reaction cross section for medium heavy nuclei at 11.8 MeV, (d,t) reactions, correlation measurements on ^8Li and ^8B, apparatus for measurement of two-particle correlations, apparatus for measurement of particle correlations, recoil proton spectrometer, dE/dx telescope for ^3He, dEXE particle separation with a multiplication stage, measurement of the form of the β spectra of ^{45}Ca, ^{90}Sr, ^{90}Y, ^{144}Ce, ^{144}Pr, and ^{166}Ho, β decay of ^{144}Pr, β–γ directional correlations of ^{126}I, ^{130}I, ^{144}Ce, ^{170}Tm, and ^{203}Hg, effect of solid-body effects on the β–γ directional correlation of ^{166}Ho, β–γ circular polarization correlations in β transitions of ^{58}Co, ^{95}Zr, ^{95}Nb, and ^{203}Hg, β–γ circular polarization correlation on ^{133}Xe, measurements of γ spectra, measurements on conversion lines with high resolution and transmission β spectrometer, proposal for measurement of neutretto mass, development of β spectrometer, construction of devices for measurement of circular polarization of γ radiation, measurement of β–γ circular polarization as function of energy and angle, principle of magnetic Compton spectrometer, and development of spark chambers, magnetic flasks, helix field spectrometer, and focusing properties of azimuthal changing magnetic fields. NSA

N67-17419# California Inst. of Tech., Pasadena.
STUDIES IN CHEMICAL DYNAMICS AND RADIATION CHEMISTRY Technical Progress Report, 1 Jul. 1965–30 Jun. 1966

Aron Kuppermann 30 Jun. 1966 52 p refs
(Contract AT(04-3)-532)
(CALT-532-1) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: diffusion kinetics; low-energy electron scattering; vacuum uv photolysis of hydrocarbons; reactions of monoenergetic deuterium atoms with hydrogen molecules; reactions in crossed molecular beams; classical trajectory calculations; quantum mechanical calculation of dissociation cross sections; and reaction cross sections and thermal rate constants. NSA

N67-17421# Comitato Nazionale per l Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
A MEASUREMENT OF THE BRANCHING RATIO $\omega \rightarrow / \omega \rightarrow \pi^+ + \pi^- + \pi^0$
G. Di Giugno, M. Giorgi, I. Peruzzi, P. Schiavon, V. Silvestrini et al 21 Jun. 1966 5 p refs Submitted for Publication *Its* Nota Interna No. 325
(LNF-66/31)

The branching ratio $\omega \rightarrow \pi^+ + \pi^- + \pi^0$ was measured at CERN using a counter technique. The value obtained was $13.4 \pm 2.6\%$ in comparison with the world average of $10.6 \pm 1\%$. Details are given on the experimental technique and method. NSA

N67-17424# Oak Ridge National Lab., Tenn.
PROTON-RECOIL NEUTRON SPECTROMETRY WITH ORGANIC SCINTILLATORS
V. V. Verbinski, W. R. Burrus, R. M. Freestone, and R. Textor [1966] 22 p refs Presented at the Symp. on Neutron Monitoring for Radiol. Protect., Vienna
(Contract W-7405-ENG-26)
(ORNL-P-2471; SM-76-13; CONF-660807-5) CFSTI: HC $3.00/MF $0.65

The possibility of using an organic scintillator as a proton-recoil neutron spectrometer is very attractive because of its high efficiency, large size, high speed, and gamma-ray discrimination capability. Its disadvantages, including nonlinear light yields to heavy particles and smeared step-like responses to monoenergetic neutrons, have been largely overcome in the two spectrometry techniques reported here. Response functions were obtained for NE-213 scintillators from Monte Carlo calculations for pulse-height distributions for monoenergetic neutrons of 0.1 to 20 MeV. Measured values of detector resolution and light yields for protons, alpha particles, and carbon ions were used in the calculation. Proton leakage from the scintillator was considered. Absolute experimental checks of the Monte Carlo calculations were made at 2.66 and 14.43 MeV with the associated particle method. These showed better than 5% overall agreement. In one spectrometry technique the family of response functions is used as input data for a spectrum unfolding code which unfolds experimental pulse-height distributions to obtain complex neutron spectra. The code is based on quadratic programming and utilizes the known nonnegativity of the neutron spectrum. An energy range of 0.7 to 18 MeV was covered with this method when pulse height distributions corresponding to 0.4 to 18 MeV proton-recoil energies were used as input to the code. In the other technique, utilizing time-of-flight methods, each response function was integrated above the discriminator level to obtain the scintillator efficiencies necessary for calculating energy spectra. With both experimental techniques, a modified Forté gamma-ray discriminator was used. It accepted neutrons from 0.25 to 20 MeV and operated effectively with 5 mr/hr of ^{60}Co gammas irradiating a 5-cm by 5-cm diam scintillator (50 mr/hr for a 2-cm diam by 1 cm scintillator). A few techniques are presented for eliminating two sources of spurious counts from the gamma-ray pulse-height distribution, thus making it possible to measure neutron and gamma-ray dose simultaneously with a single detector. Several proposed methods of neutrons and gamma ray dosimetry are outlined. Author (NSA)

N67-17433# Oak Ridge National Lab., Tenn.
SECONDARY STANDARDIZATIONS USING DIGITAL COMPUTER TECHNIQUES TO NORMALIZE MULTIPLE GAMMA-RAY SPECTRA FOR DIRECT EFFICIENCY DETERMINATIONS
J. S. Eldridge [1966] 14 p refs Presented at the IAEA Symp. on the Standardization of Radionuclides, Vienna
(Contract W-7405-ENG-26)
(ORNL-P-2432; CONF-661012-1) CFSTI: HC $3.00/MF $0.65

A library of statistically tested gamma spectra has been collected for absolutely assayed sources of 42 radionuclides. Techniques for use of the library data in a direct assay method as well as a computer system of gamma spectral resolution have been developed. It has been shown that secondary standardizations of radionuclides may be performed with this library with accuracies of 1–5%. A single nuclide standard used in conjunction with the library data permits a rapid determination of radioactive source strength in many spectrometer systems. Author (NSA)

N67-17451# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
NEW DATA ON THE CONVERSION ELECTRON SPECTRA OF Dy^{153} Dx^{155}, AND Dy^{157} [NOVYE DANNYE O SPEKTRAKH KONVERSIONNYKH ELEKTRONOV Dy^{153}, Dy^{155}, I Dy^{157}]
V. Gnatovich, K. Yagromov, and F. N. Mukhtasimov 1966 22 p refs
(JINR-P-2729)

The spectra of the conversion electrons of ^{153}Dy, ^{155}Dy, and ^{157}Dy were measured using a permanent magnet spectrograph, and the data were tabulated. The decay modes of these isotopes were also considered. NSA

N67-17455# Illinois Univ., Urbana.
REACTION DYNAMICS IN CROSSED MOLECULAR BEAMS
Oakley H. Crawford (Ph.D. Thesis) 1966 167 p refs
(Contract AT(04-3)-532)
(CALT-532-3) CFSTI: HC $3.00/MF $0.65

An apparatus constructed to use crossed molecular beams to study reaction dynamics is described. Beams are produced and defected in this apparatus. However, scattering measurements were not made because of insufficiently high signal-to-noise rates. Features of design and construction of the apparatus are presented. Computer programs are used to analyze a realistic set of hypothetical experimental results. Two important conclusions are drawn. First, it is feasible to calculate precise expectation values of laboratory signals corresponding to assumed velocity-differential reaction cross sections. Spreads of reactant beams in direction, speed, and spatial extension, as well as the size and directionality of the detector entrance, are properly taken into account. With modifications, the technique should be applicable to other crossed-beams experiments also, such as those using velocity selection of a product, or no velocity selection at all. The second conclusion is that detailed information about reaction dynamics can be extracted from this type of experiment, while at the same time a good value of the total reaction cross section is very hard to obtain. The possibilities and limitations of a method of interpreting experimental data are illustrated in a set of realistic examples. Practical consequences in terms of design of experiments are given. Author (NSA)

N67-17458# Princeton Univ., N. J. Palmer Physical Lab.
APPLICATION OF MULTIPARTICLE COLLISION THEORY TO THE STUDY OF DIRECT NUCLEAR REACTIONS
Julian V. Noble (Ph.D. Thesis) Aug. 1966 115 p refs
(Contract AT(30-1)-937)
(PUC-937-227) CFSTI: HC $3.00/MF $0.65

The solution of problems in nuclear physics from the viewpoint of multi-particle collision theory is considered. Nonrelativistic collision theory is briefly reviewed, with particle emphasis on recent developments in multiparticle potential scattering theory. A set of linear integral equations describing deuteron scattering is derived using methods similar to those of Faddeev. These equations (of the Fredholm type) are contrasted with the usual distorted-wave Born approximation treatment of deuteron reactions. Various simplified versions of these equations are then described, and the numerical solution of a simple test is discussed. An existence proof of spurious homogeneous solutions of Weinberg's three-body equations (in a special case), a new set of three-particle scattering equations particularly suited to deuteron collisions, and a new method of proof of the existence of the analytic continuations of three-particle amplitudes (defined for complex energy) to real, positive energies are included. Author (NSA)

N67-17459# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INVESTIGATION OF THE DIFFUSION OF THE NUCLEAR REACTION RECOIL PRODUCTS IN DIFFERENT MATERIALS [ISSLEDOVANIE DIFFUZII PRODUKTOV YADERNYKH REAKTSII V RAZLICHNYKH MATERIALAKH]
N. I. Tarantin, V. V. Gordeev, and A. V. Dem'yanov 1966 14 p refs
(JINR-P-2804)

Results are given for studies on release time of the nuclear reaction recoil products, trapped in a plate heated to 1750°C. It was found that ≈50% of Dy nuclei, trapped in a tantalum plate, were emitted during ≈0.1 sec. The experiments were aimed at use of this method for the introduction of reaction products into the ion source of the electromagnetic separator, required for quick identification of short-lived nuclear reaction recoil products. Author (NSA)

N67-17461# Los Alamos Scientific Lab., N. Mex.
A MONTE CARLO SIMULATION OF A PROTON–PROTON SPIN CORRELATION EXPERIMENT
H. C. Bryant and Nelson Jarmie 17 Oct. 1966 43 p refs
(Contract W-7405-ENG-36)
(LA-3558) CFSTI: HC $3.00/MF $0.65

A FORTRAN IV Code is described that simulates in detail the results to be expected from a proton–proton spin correlation measurement for various assumed values for the correlation coefficient C_{nn}. The life history of a successful event is described with explanations of the more important computational algorithms. Multiple scattering, relativistic, and energy cut-off effects are included. Plots of many of the more significant variable distributions and a listing of the code, CNNJ9, are presented. Author (NSA)

N67-17463# Los Alamos Scientific Lab., N. Mex.
CALCULATION OF THE PHOTO-ELECTRIC ABSORPTION COEFFICIENT BY THE STATISTICAL METHOD
David A. Liberman and Ivan Cherry 19 Oct. 1966 12 p refs
(Contract W-7405-ENG-36)
(LA-3581-MS) CFSTI: HC $3.00/MF $0.65

The photo-electric absorption coefficient (including transitions from one bound state to another) is calculated using the statistical (Thomas–Fermi) model. Author (NSA)

N67-17478# Henry Ford Hospital, Detroit, Mich. Edsel B. Ford Inst. for Medical Research.
A COMPILATION OF BETA EXCITED X-RAY SPECTRA, PART I AND FORWARD (^{147}Pm, ^{45}Ca, ^{32}P), 1 SEPTEMBER 1964–31 AUGUST 1965
Luther E. Preuss Nov. 1966 205 p refs
(Contract AT(11-1)-1239)
(TID-22361, Pt. 1) CFSTI: HC $3.00/MF $0.65

This laboratory has embarked upon the fabrication of a selected number of beta-excited x-ray sources and the compilation of the spectra from these sources. Thirty-one elements are utilized as target materials and eleven beta emitters are contemplated. A certain standardization is carried out in the study. Assay parameters involving detectors, geometry, etc., are held constant and recorded throughout the compilation so that source intercomparison is possible between spectra from variants of a single-source type, as well as between different source types. Part I consists of the cataloging of the above target elements with ^{147}Pm, ^{45}Ca, and ^{32}P. Ensuing parts shall include beta-excited spectra from the balance of the useful pure beta emitters. The following basic source designs are utilized: the apposition source, the mixture source, and the compound beta-excited x-ray source. Each of these has some relation to the practical beta-excited source that may be fabricated. The compilation is intended to provide a convenient and rapid, qualitative as well as quantitative, reference for the worker utilizing the beta-excited phenomena. Author (NSA)

N67-17479# California Univ., Berkeley. Lawrence Radiation Lab.
FORTRAN SUBROUTINE RANGE: CALCULATING THE RANGE-ENERGY RELATION FOR CHARGED PARTICLES IN CHEMICAL ELEMENTS
N. Peter Trower 1 Sep. 1966 29 p refs
(Contract W-7405-ENG-48)
(UCRL-11647 Rev.) CFSTI: HC $3.00/MF $0.65

FORTRAN subroutine RANGE calculates the differential energy loss and the range of charged particles, electrons and positrons excepted, with kinetic energies between 1 MeV and 500 BeV in any chemical element. With the results of the element calculations, the energy loss and range can be readily computed for chemical compounds and mixtures. Author (NSA)

N67-17491# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
RADIATIVE UNIT AND CRITICAL ENERGY IN Xe [O RADIATSIONNOI EDINITSE I KRITICHESKOI ENERGII V Xe]
B. Nichiporuk, B. Slovinskii, and Z. S. Strugal'skii 1966 5 p refs In RUSSIAN
(JINR-P-2808)

Correlation of theoretical results with experimental data obtained during irradiation of a 55-cm xenon bubble chamber with 9 BeV/c mesons (π^-) showed that the cross sections obtained for the absorption of γ quanta in Xe ($\sigma_\gamma = 19.0 \pm 0.8$) is in good agreement with the theoretical results. NSA

N67-17495# Joint Inst. for Nuclear Research, Dubna (USSR).
INVESTIGATION OF THE DECAY SCHEME OF ^{138}Pr [IZUCHENIE SKHEMY RASPADA ^{138}Pr]
R. Babadzhanov, Ya. Vrzal, K. Ya. Gromov, Ya. Liptak, V. A. Morozov et al 1966 24 p refs In RUSSIAN
(JINR-P-2819)

Two previously unreported energy levels at 2371.8 and 2482.6 keV with spins of 5 or 6 and 6^+ or 7^+, respectively, were observed in a study of the decay of isomeric ^{138}Pr. Two previously unreported β^+ components with energies of 1.41 and 1.56 MeV were found. An assignment of 6^- was made for the isomeric state of ^{138}Pr. NSA

N67-17499# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CALCULATION OF NUCLEON–PHONON INTERACTION EFFECTS IN A SIMPLE NUCLEAR MODEL

E. S. Bal'butsev, R. V. Dzholos, and I. N. Mikhailov 4 Jun. 1966 18 p refs Submitted for Publication
(JINR-E-2772)

The results of calculation of the energy spectra in a simple model with nucleon–phonon interaction are given. Comparison of the exact values of the energy with evidence obtained by strong coupling methods allows one to find the range of application of this method. It is shown that the conditions under which the equidistant character of the spectrum is revealed are considerably wider than those under which the collective degree of freedom is extracted. Author (NSA)

N67-17500# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

CLOSED SHELLS FOR Z>82 AND N>126 IN A DIFFUSE POTENTIAL WELL [ZAMKNUTYE OBOLOCHKI S Z>82 I N>126 V RASCHETAKH S DIFFUZIONNYM POTENTSIALOM]

F. A. Gareev, B. N. Kalinkin, and A. Sobichevski 1966 8 p refs In RUSSIAN
(JINR-P-2793)

Proton and neutron single-particle levels in a Woods–Saxon potential well with a spin-orbit term are calculated for Z>82 and N>126 as functions of the mass number A. The possible magic numbers are found to be Z=114 and N=184. Author (NSA)

N67-17521# Brookhaven National Lab., Upton, N. Y.

CROSS SECTIONS FOR TRANSURANIUM ELEMENT PRODUCTION

S. Pearlstein May 1966 58 p refs
(Contract AT(30-2)-GEN-16)
(BNL-982) CFSTI: HC$3.00/MF$0.65

An evaluation of cross sections useful for determining the production of transuranium elements is presented. The measured thermal cross sections and resonance integrals for the heavy elements beginning with ^{234}U were collected. Resonance parameters reported in BNL-325 were used in a single-level formalism to reconstruct the total and partial neutron cross sections as a function of energy for the nuclides ^{236}U, ^{237}Np, ^{238}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{243}Am, and ^{244}Cm. A single scattering radius, adjusted for best fit in the valleys between resonances, was used and a 1/v background cross section added to account for the low-energy tails of the unresolved resonances. Good fits to the measured total and partial cross sections were observed throughout the resolved resonance region for most nuclides, but strong resonance–resonance interference effects were noted for ^{241}Pu. An integral over energy of the product of the absorption or fission cross section and a 1/E flux from a low energy limit of 0.55 eV was calculated as a function of energy in the resolved resonance region. An extrapolation to high energies allowed comparison with measured resonance integrals. Good agreement between extrapolated resonance integrals and measurements was noted for all cases except ^{238}Pu and ^{237}Np. Information is reported on the capture integrals of ^{241}Pu, ^{241}Am, and ^{244}Cm and the fission integral of ^{241}Am. Author (NSA)

N67-17524# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.

DIFFERENTIAL CROSS SECTION OF ^{18}O(t,α)^{15}N AND ^{18}O(t,p)^{18}O REACTIONS AT ENERGY RANGE FROM 0.6 TO 1.75 MeV [DIFFERENTSIAL'NYE SECHENIYA REAKTSII ^{18}O(t,α)^{15}N I ^{18}O(t,p)^{18}O V INTERVALE ENERGII 0.6–1.75 MeV]

A. P. Kobzev, A. V. Gromov, K. Kashlik, K. Nedvedyuk, V. I. Salatskii et al. 1966 9 p refs In RUSSIAN
(JINR-P-2796)

Measurements were made on the reactions ^{18}O(t,α_0)^{15}N, ^{18}O(t,α_{1+2})^{15}N*, ^{18}O(t,p)^{18}O, and ^{18}O(t,p_1)^{18}O* at 90° and at triton energies from 0.6 to 1.75 MeV. The energy levels of ^{19}F were studied. NSA

N67-17525# Los Alamos Scientific Lab., N. Mex.

DEPENDENCE OF NUCLEO-SYNTHESIS ABUNDANCE CALCULATIONS ON THE MASS LAW

Philip A. Seeger 27 Aug. 1966 32 p refs Presented at the Intern. Symp. on Why and How Should We Investigate Nuclides Far off the Stability Line, Lysekil, Sweden, 21–27 Aug. 1966
(Contract W-7405-ENG-36)
(LA-DC-7885; Conf-660817-4) CFSTI: HC$3.00/MF$0.65

A qualitative model of the r-process (i.e., stellar nucleosynthesis by neutron capture on a rapid time scale) is presented. A semi-empirical mass law is used to estimate neutron binding energies and β-decay probabilities for isotopes which are as much as 50 mass units heavier than the valley of β-stability. Peaks in the solar system isotopic abundance curve indicate the influence of shell-structure magic numbers in these heavy isotopes; simple parabolic terms in the mass law, if determined independently from deformations, were found adequate to reproduce the observed abundances. However, it is found that additional mass law terms, which greatly improve the fit to known masses near β-stability, often override the shell effects terms in the super-heavy region, and destroy the calculated abundance peaks. Several examples of mass laws and the resulting abundance calculations are considered. Author (NSA)

N67-17526# Oak Ridge National Lab., Tenn.

DEPENDENCE OF BRUECKNER-HARTREE-FOCK CALCULATIONS FOR LIGHT NUCLEI ON DETAILS OF THE NUCLEON-NUCLEON INTERACTION: COMPARISON OF THE YALE, HJ, AND REID POTENTIALS

Richard L. Becker, A. D. MacKellar (MIT, and B. M. Morris [1966] 9 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn. Sponsored Jointly by MIT
(Contract W-7405-ENG-26)
(ORNL-P-2468; Conf-660906-25)

Calculations of matrix elements of Brueckner's reaction matrix and the Bethe–Goldstone wave functions for pairs of nucleons in light nuclei were carried out for the three currently most prominent phenomenological nucleon–nucleon interactions. Significant differences in binding energies, single-particle energies, spin-orbit splittings, and effective interactions are found. The proton-proton correlation function was derived and evaluated. Author (NSA)

N67-17528# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

GAMMA-RAY SPECTROMETRY OF NEUTRON-DEFICIENT ISOTOPES Annual Progress Report

R. L. Heath and J. E. Cline Jun. 1966 141 p refs
(Contract AT(10-1)-205)
(IDO-17188) CFSTI: HC$3.00/MF$0.65

Progress in a program of studies of neutron-deficient nuclides using the techniques of gamma spectroscopy is reported. The major objective of this program has been to produce a set of pulse height spectra representing the response of a standard gamma scintillation spectrometer to radiations emitted in the decay of neutron-deficient nuclides. These spectra are subsequently processed and included in the Scintillation Spectrometry Gamma-Ray Spectrum Catalogue. This effort has been expanded to include a compilation of spectra taken with lithium ion-drifted germanium detectors. This latter effort also includes the measurement of precise gamma energies for use as secondary standards. A discussion of the techniques employed in the collection of the spectra using Ge(Li)

detectors is presented. Work during the year has included the production of over 50 neutron-deficient nuclides by gamma and proton induced reactions using an electron linear accelerator and a cyclotron. Spectra of over 30 individual nuclides are presented in final form. Author (NSA)

N67-17530# Brookhaven National Lab., Upton, N. Y.
TABLES GIVING THE INTERNAL CONVERSION COEFFICIENTS OF γ-RADIATION ON THE K-SHELLS AND L-SHELLS
L. A. Sliv and I. M. Band Jan. 1966 11 p Transl. into ENGLISH from Russian
(BNL-TR-65)

The equations and methods used in obtaining the values for the tables are given. The electrostatic potential outside the nucleus was selected taking into account the shielding obtained using the Thomas–Fermi–Dirac method. The eigenvalues of energy e-eigenvalue and the G and F eigen-functions of the bound electrons were obtained simultaneously. All the calculations were carried out twice on the BESM-1 computer of the Academy of Sciences of the USSR with a numerical integration of the differential equation system; after the first time, the numerical integration relative error of the equation did not exceed 10^{-5}, after the second time it was 0.5×10^{-7}. In this case, the difference in the eigenvalues was less than 10^{-6}. The eigenvalues were determined with the D exchange correction taken into account and without it. NSA

N67-17533# International Atomic Energy Agency, Vienna (Austria).
BULLETIN OF THE INFORMATION CENTRE ON NUCLEAR DATA, NO. 2
V. N. Andreev et al 1965 234 p refs Transl. into ENGLISH from Byul. Inform. Tsentr. Yadern. Dannym (USSR), no. 2, 1965 p 5–232
(INDSWG-101)

Conference papers are presented on various aspects of nuclear reactions. Considerations are given to the reactions accompanied by the emission of charged particles caused by slow neutrons. Discrete resonance level parameters, and both inelastic and elastic scattering of neutrons are discussed. Details are reported on cross sections of neutron reactions accompanied by emission of charged particles, and on cross sections of the following isotopes for fission produced by 150–660 MeV protons: ^{181}Ta, Re, Pt, ^{197}Au, Pb, ^{209}Bi, ^{232}U, ^{238}U. N.E.N.

N67-17535# Daresbury Nuclear Physics Lab. (England).
NINA: THE 4 GeV ELECTRON SYNCHROTRON OF THE NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE
[1966] 22 p
(DNPL-1)

A progress report is presented on the 4 GeV electron synchrotron NINA. Topics discussed are laboratory buildings, magnet, magnet power supply, rf accelerating system, vacuum system, and injection system. NSA

N67-17541# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
REMARKS ON INVESTIGATION π^--p INTERACTIONS IN HEAVY LIQUID BUBBLE CHAMBERS [OB IZUCHENII π^--p VZAIMODEISTVII V PUZYR'KOVOI KAMERE S TYAZHELOI ZHIDKOST'YU]
Ya. S. Elenskii and V. A. Shebanov 1966 16 p refs In RUSSIAN; ENGLISH summary
(NP-16278; Rept.-423)

The percentages of interactions on free protons (n_1) and on bound protons without nuclear breakup (n_2) of H-like events (n_1+n_2) were measured in a propane-xenon bubble chamber at 2.8 BeV/c. In addition to 3000 pictures in propane-xenon bubble chamber about 3000 photos in freon and 3000 photos in xenon bubble chambers were analyzed. The difference method was used to determine the ratio $\alpha_{B.c.}=n_2/n_1+n_2$. The result is $0.37\leq\alpha_{B.c.}\leq0.62$ for the various H-like reactions, when kinematical selection criteria were not used. Besides that from the data, obtained in the bubble chamber the value $\alpha_{s.c.}$ was evaluated for possible spark chamber experiments when spark chamber electrodes contain free hydrogen. $\alpha_{s.c.}$ is close to $\alpha_{B.c.}$ if the electrode thickness is less 0.2 g/cm^2. Author (NSA)

N67-17549# Massachusetts Inst. of Tech., Cambridge.
SHELL EFFECTS IN THE HIGH ENERGY PHOTOPROTON SPECTRA FROM ^{6}Li
J. L. Matthews, W. Bertozzi, S. Kowalski, C. P. Sargent, and W. Turchinetz Jul. 1966 8 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 12–17 Sep. 1966
(Contract AT(30-1)-2098)
(MIT-2098-256; CONF-660906-5) CFSTI: HC $3.00/MF $0.65

Measurements were made of the energy spectra and angular distributions of protons from the ^{6}Li(γ,p) reaction. The experiment was performed at the Saskatchewan Accelerator Laboratory using a bremsstrahlung beam of maximum energy ≈100 MeV. Structure observed in the photoproton spectra can be interpreted on the basis of a single-particle direct-interaction model. Author (NSA)

N67-17550# Illinois Univ., Urbana.
X-RAY DIFFRACTION STUDY OF ATOMIC ORDERING IN TWO SIGMA PHASES
R. W. Spor, H. Claus, and Paul A. Beck 11 Aug. 1966 18 p refs Presented at the 15th Ann. Conf. on Applications of X-ray Anal., Denver, 10–12 Aug. 1966
(Contract AT(11-1)-1198)
(COO-1198-385; CONF-660814-1) CFSTI: HC $3.00/MF $0.65

The structure and ordering of sigma phases formed by transition metal alloys are discussed. An experimental study was made of the ordering in the sigma phases of Cr–Re and Fe–Re alloys. The results compared with those of previous studies, show that ordering in (Fe–Re)σ corresponds to the usual arrangement (the larger X atoms tend to occupy the high coordination number sites), while inverse ordering is found for (Cr–Re)σ owing to the inverse size relationship ($V_X/V_Y<1$). NSA

N67-17552# California Univ., Berkeley. Lawrence Radiation Lab.
TEST OF A MICROSCOPIC DESCRIPTION OF NICKEL ISOTOPES BY INELASTIC PROTON SCATTERING
Norman K. Glendenning, B. G. Harvey, D. L. Hendrie, O. N. Jarvis, and Jeanette Mahoney Jul. 1966 10 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 12–17 1966
(Contract W-7405-ENG-48)
(UCRL-16984; CONF-660906-17) CFSTI: HC $3.00/MF $0.65

The inelastic scattering of protons from ^{58}Ni and ^{60}Ni is compared with the results of a coupled-channel scattering calculation using a microscopic nuclear description. Comparison with DWBA results shows the necessity for a full coupled-channel treatment. It is shown that this kind of analysis provides a sensitive test of nuclear wave functions. Suggestions for improving the wave functions of these nuclei are made. Author (NSA)

N67-17554# Oak Ridge National Lab., Tenn.
A SEARCH FOR THE TRINEUTRON
S. T. Thornton, C. M. Jones, J. K. Bair, and H. B. Willard [1966] 8 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 12–17 Sep. 1966
(Contract W-7405-ENG-26)
(ORNL-P-2412; CONF-660906-21) CFSTI: HC$3.00/MF$0.65

Experimental and theoretical evidence was recently proposed for the existence of the trineutron, a stable particle composed of three neutrons bound by 1.0 MeV. A search for the trineutron in the reaction $T(n,p)n^3$ with 20.8-MeV neutrons was made, and no evidence for the existence of the trineutron was found. Author (NSA)

N67-17559# California Univ., Livermore. Lawrence Radiation Lab.
PHOTONEUTRON MEASUREMENTS OBTAINED WITH MONOCHROMATIC PHOTONS
S. C. Fultz [1966] 12 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn.
(Contract W-7405-ENG-48)
(UCRL-70002; CONF-660906-16) CFSTI: HC$3.00/MF$0.65

Some results obtained on photoneutron cross section measurements made with the use of the Livermore monochromator are discussed. It is shown that the data agree well with the predictions of the classical photonuclear theory. Data is presented on the cross sections for neutrons and protons emitted from ^{16}O in transitions to excited states, and on (γ,n) and $(\gamma,2n)$ cross sections for zirconium isotopes. Author (NSA)

N67-17569# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
CERTAIN PECULIARITIES OF SCHRODINGER EQUATION SOLUTIONS FOR POTENTIALS WITH COULOMB "TAILS" [NEKOTORYE SVOISTVA RESHENII URAVNENIYA SHREDINGERA DLYA POTENTSIALOV S KULONOVSKIM "KOHVOSTOM"]
A. M. Perelomov, V. S. Popov, and I. V. Terent'ev 1966 12 p refs In RUSSIAN; ENGLISH summary
(NP-16280; Rept.-435)

For the potentials of the type $V(z) \rightarrow l/r$, $r \rightarrow \infty$ the asymptotic form of the wave function $\psi_{lm}(z)$ at $xz >> l$ was found and the character of the singularity $\phi_{lm}(\phi)$ at the point $\phi^2 = -x^2$ was determined. The connection between the coefficient C_{xl} and the residue of the scattering matrix $S_l(k)$ at the pole $k=ix$ corresponding to the bound state was found. The conditions when the deviation $V(z)$ at small r from the purely Coulomb potential does not break the level spectrum higher symmetry described by the group O(4) were obtained. Author

N67-17570# Atomics International, Canoga Park, Calif.
AN ADAPTATION OF THE ORNL M-GAM CODE FOR USE AT ATOMICS INTERNATIONAL
J. G. Morgan and R. A. Blaine Mar. 1966 53 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-12019) CFSTI: HC$3.00/MF$0.65

A consistent P_1 multigroup code for the calculation of fast-neutron spectra and multigroup constants is described. The maximum number of fast groups allowed is 68. A large library tape is used with this code. Author (NSA)

N67-17589# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.
THE NIMROD ELECTROSTATIC INFLECTOR
K. D. Srivastava Jul. 1966 16 p refs
(RHEL/R-125) HMSO: 2s 6d

The development of the electrostatic inflection system used on NIMROD, the 7-Bev proton synchrotron, is described. The work was aimed at improving its operational reliability. Author (NSA)

N67-17582# California Univ., Berkeley. Lawrence Radiation Lab.
A MEASUREMENT OF THE RELATIVE BRANCHING RATIO $K^+ \rightarrow \mu^+ + \nu / K^+ \rightarrow \pi^+ + \pi^o$.
Robert Lamar Beck (Ph.D. Thesis) 28 Jul. 1966 62 p refs
(Contract W-7405-ENG-48)
(UCRL-16003) CFSTI: HC$3.00/MF$0.65

K^+ mesons in a momentum-analyzed beam were identified by a velocity selecting Cherenkov counter and brought to rest in a beryllium target which served as a source for a broad-range magnetic spectrometer. Muons and pions from the decay modes $K+ \rightarrow \mu^+ + \nu$ (P_μ=236 Mev/c) and $K^+ \rightarrow \pi^+ + \pi^0$($P_\pi$=205 Mev/c) were identified by momentum and range, and a value 2.31 ± 0.24 for the relative branching ratio $K\mu 2 / K\pi 2$ was obtained. The value is compared with results of other experiments. Author (NSA)

N67-17594# California Univ., Berkeley. Lawrence Radiation Lab.
PRODUCTION OF $K\bar{K}$ PAIRS IN $\pi^- p$ INTERACTIONS
Richard Irwin Hess (Ph.D. Thesis) 24 Jun. 1966 86 p refs
(Contract W-7405-ENG-48)
(UCRL-16832) CFSTI: HC$3.00/MF$0.65

The 72-inch hydrogen bubble chamber was exposed to a beam of π^- mesons having laboratory momenta of 2.0, 3.1, and 4.0 Bev/c. The final states containing a $K\bar{K}$ pair included many cases of resonance production. In particular evidence for production of the ϕ, A_2, D and E mesons was found. The cross sections at 3.1 Bev/c are $\sigma(\pi^- p \rightarrow p A_2^-,\ A_2^- \rightarrow K\bar{K}) = 18 \pm 4$ μb, $\sigma(\pi^- p \rightarrow n A_2^0,\ A_2^0 \rightarrow K\bar{K}) = 36 \pm 10$ μb, $\sigma(\pi^- p \rightarrow nD,\ D \rightarrow K^0 K^+ \pi^+) = 7 \pm 2$ μb, and $\sigma(\pi^- p \rightarrow nE,\ E \rightarrow K^0 K^+ \pi^+) = 17 \pm 5$ μb. The reaction $\pi^- p \rightarrow n\phi$ proceeds with a cross section of 30 ± 8 μb at 2.0 Bev/c. The quantum numbers $I^G J^P = 1^-$ even$^+$ ($J = 0$ excluded) were established for the A_2 meson; though our determination is not conclusive, $I^G J^P = 0^+ 1^+$ for both the D and E mesons are favored. Author (NSA)

N67-17597# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SPONTANEOUSLY FISSIONABLE ISOMER WITH THE HALF-LIFE EQUAL TO 10^{-7} s [SPONTANNO DELYASHCHIISYA IZOMER S PERIODOM POLURASPADA 10^{-7} SEK]
Yu. P. Gangrskii, B. N. Markov, S. M. Polikanov, and Kh. Yungklaussen 1 Apr. 1966 8 p refs In RUSSIAN
(JINR-P-2841)

A spontaneously fissioning isomer with a half life of $0.8 \pm 0.3 \times 10^{-7}$ sec was produced in ^{12}C reactions with ^{238}U. On the basis of the excitation function, the isomeric state was attributed to ^{240}Cf. The cross section for the production of the isomer was determined to be $1.2 \pm 0.5 \times 10^{-32}$ cm^2. NSA

N67-17600# California Univ., Berkeley. Lawrence Radiation Lab.
REACTION CHANNELS IN THE CAPTURE OF K^--MESONS BY COMPLEX NUCLEI
Jack W. Patrick (Ph.D Thesis) 1 Mar. 1966 116 p refs
(Contract W-7405-ENG-48)
(UCRL-16602) CFSTI: HC$3.00/MF$0.65

A total of 13,600 K^--mesons at rest were observed in two nuclear emulsion stacks. The emission of hyperons, pions, and hyperfragments from 3900 of the K^--capture-stars was studied extensively. The identification of the hyperons is discussed. Charged Σ-hyperons are emitted from (17.3±1.2) percent of all K^- stars in the completely analyzed stack from which the figures following are quoted. The Σ^+/Σ^- ratio for all stars is 1.08±0.08, while the proportion of stars from which pions are emitted is 0.38±0.05. About 11 percent of all identified charged Σ-hyperons had an energy above 60 Mev, and were therefore attributed to multinucleon reaction channels. The proportion of all multinucleon primary reaction processes may be as high as 46 percent. A detailed examination of the pion-emitting events and of the sign ratio of the mesons has led to an estimate of the probabilities of absorption of Σ-hyperons in the parent nucleus, and to a partition of events between the various single-nucleon reaction channels. On the basis of the Coulomb barrier and Auger electron emission, discrimination is made between K^- capture on light (C,N,O) nuclei and on heavy nuclei (Ag, Br). For the single-nucleon reaction channels it is found that K^- capture by a light nucleus is 1.16 times as likely to produce a pion as a K^- capture by a heavy nucleus. For the multinucleon channels, it is determined that K^- interaction with a light nucleus is 2.36 times as likely to produce a fast (T_Σ>60 Mev) Σ-hyperon as interaction with a heavy nucleus. The mechanism of light (Z<7) hyperfragment formation, excluding cryptofragments, is shown by analysis of the pion spectra accompanying the hypernuclear prong to be primarily one of Σ conversion (80 percent). A study of the relative number of captures on light and on heavy nuclei yielded the result that less than 20 percent of the production of these light hyperfragments took place on heavy nuclei. Further, a limit of 30 percent was placed on the fraction of light hyperfragments produced in multinucleon reactions. Evidence for the $Y^*_0(1405)$ is studied with $\Sigma\pi$ mass spectra from K^- interactions on 12C. The results can be explained on an impulse model without recourse to resonance formation. Production of Y^*_0 with a width of <20 Mev is not confirmed. Author (NSA)

N67-17616*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COUPLED VIBRATION AND DISSOCIATION RELAXATION BEHIND STRONG SHOCK WAVES IN CARBON DIOXIDE

Franz J. Hindelang Washington, NASA, Feb. 1967 36 p refs

(NASA-TR-R-253) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The harmonic oscillator rigid-rotator model has been used to calculate the relaxation region behind a shock wave in carbon dioxide. Finite relaxation rates for the three different vibrational modes and two dissociation reactions are included. Two different models for the vibrational excitation have been examined. Solutions were obtained for the interdependent fluid-flow, chemical rate, and vibrational relaxation-rate equations incorporating estimated rate coefficients. Results are presented in the form of flow-filed profiles for density, pressure, translational and vibrational temperatures, and species concentrations. The effect of vibrational relaxation and vibration-dissociation coupling as much stronger in CO_2 with three different vibrational modes than in diatomic gases with only a single mode. The effect of coupled vibrational relaxation and dissociation can sometimes alter the flow-field profiles by a factor of 2 compared to similar calculations without such coupling. For vibrational relaxation, the results indicate that shock-wave profiles depend primarily on the rate at which the translational energy is fed into internal modes and not so strongly on the energy distribution among the modes. Author

N67-17620*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

MEASUREMENT OF NEUTRON SPECTRA IN LIQUID HYDROGEN Final Report

G. D. Trimble, G. K. Houghton, and A. E. Profio 17 Jul. 1966 239 p refs

(Contract NAS3-6217)

(NASA-CR-72143; GA-7309) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Differential energy flux neutron spectra was measured in a two-dimensional geometry represented by a cylindrical cryostat of liquid hydrogen with a small spherical isotropic fission source externally located on the axis of the cylinder. These spectra were obtained by time-of-flight techniques using a high-intensity pulsed source of neutrons generated by an electron linear accelerator. The experimental facility, procedures and techniques, and data reduction are described. Calculations reported for each measurement were obtained by using the one-dimensional transport theory code GAPLSN; and these measured results are compared with the theoretical predictions. Checkoff lists for each set of measurements and operational emergency procedures are included, as are printouts of the tabulated data of the spectral measurements. M.W.R.

N67-17621*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF THE (d,α) REACTION ON ALUMINUM 27

Joseph R. Priest and John S. Vincent Washington, NASA, Feb. 1967 19 p refs

(NASA-TN-D-3548) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Angular distributions of seven alpha-particle groups from the (d,α) reaction on aluminum 27 were measured. The deuteron energy was 20.9 MeV in the laboratory system. The angular distributions are all peaked in the forward direction and have little structure. The integrated differential cross sections for those reactions that leave the Mg^{25} nucleus in the $K=5/2^+$ rotational states are, in general, more than one order of magnitude larger than those that leave Mg^{25} in the $K=1/2^+$ rotational states. The angular distributions corresponding to a given rotational band in Mg^{25} are strikingly similar both in magnitude and shape. Analysis of the energy level structure in terms of the rotational model indicates that the state in Mg^{25} at 5.47±0.03 MeV is the $11/2^+$ member of the $K=5/2$ band. Author

N67-17664# Stanford Univ., Calif. High Energy Physics Lab.

MAGNETIC DIPOLE DISINTEGRATION AND MAGNETIC FORM FACTOR OF THE DEUTERON AT HIGH MOMENTUM TRANSFERS BY 180° ELECTRON SCATTERING

R. E. Rand, R. F. Frosch, C. E. Littig, and M. R. Yearian Oct. 1966 17 p refs Submitted for Publication

(Contract Nonr-225(67))

(HEPL-463; AD-643085) CFSTI: HC $3.00/MF $0.65

Disintegration and elastic scattering cross sections have been measured for 180 degree electron scattering from the deuteron. The elastic scattering cross sections confirm earlier results. The disintegration cross sections near threshold are considerably higher, at large momentum transfers, than the values predicted by simple impulse approximation calculations. This effect might be attributed to meson exchange currents. Author (TAB)

N67-17681# Oak Ridge National Lab., Tenn.

ANALYSIS OF THE ANALOGUE STATE RESONANCES IN $^{208}Pb(p,p_0)^{208}Pb$ AND $^{208}Pb(p,p')^{208}Pb^*$ PROCESSES

Taro Tamura [1966] 7 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn.

(Contract W-7405-ENG-26)

(ORNL-P-2438; Conf-660906-18) CFSTI: HC $3.00/MF $0.65

Analysis was made of the data on the analogue state resonances in the $^{208}Pb(p,p_0)^{208}Pb$ and $^{208}Pb(p,p')^{208}Pb^*$ processes in terms of an extended coupled-channel calculation. Rather good agreement with experiment was obtained. The derived spectroscopic factor was also in accord with that obtained from a (d,p) analysis. Author (NSA)

N67-17686# Princeton Univ., N. J. Palmer Physical Lab.
COUPLED CHANNELS AND THEIR APPLICATION TO RESONANCES IN THE SCATTERING OF LOW-ENERGY NEUTRONS BY CARBON 12
John Louis Roeder (Ph.D. Thesis) Sep. 1966 196 p refs
(Contract AT(30-1)-937; Grant NSF GP-579)
(PUC-937-219) CFSTI: HC$3.00/MF$0.65

The importance of channel coupling in nuclear reactions is discussed, and the coupled Schrödinger equations solved in many-channel calculations for nuclear reactions are formulated. The solutions are discussed in detail, particularly from the viewpoint of the reaction and transition matrices. Coupled-channel computer calculations are presented for low-energy neutron scattering by ^{12}C and for other examples of more general interest, in which resonances are investigated from the viewpoints of scattering cross sections, phase shifts, and poles of the transition matrix. Many of these resonances are seen to arise from channel coupling. Wherever possible, the results of calculations are compared with analytic results which have been obtained only for special cases. The behavior of resonances near channel thresholds is also discussed. NSA

N67-17689# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
COMPENSATION OF THE DETUNING EFFECTS IN THE RESONATING CAVITY OF AN ACCELERATOR [COMPENSAZIONE DEGLIEFETTI DEL DISACCORDO NELLE CAVITA' RISONANTI DELLE MACCHINE ACCELERATRICI]
D. Fabiani and M. Puglisi 24 May 1966
(LNF-66/28)

Resonators are used in storage rings to maintain the particles in orbit. The amplitude and the phase of the electric field must be kept constant in these resonators. The difficulties encountered are examined. A simple solution for these problems is indicated. The functioning of the final amplifier-cavity group is analyzed, and a correction circuit is given. Experimental results indicate that this control circuit makes it possible to compensate completely the effects of dephasing on the amplitude and phase of the input voltage. NSA

N67-17691# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
CALCULATIONS OF THE ION MOTION IN THE CENTRAL REGION OF CYCLOTRON WITH AZIMUTHAL DISPLACEMENT OF THE SOURCE [RASCHET DVIZHENIYA IONOV V TSENTRAL'NOI OBLASTI TSIKLOTRONA PRI POVOROTE ISTOCHNIKA]
S. I. Kozlov, R. Ts. Ogaiesyan, Pek Dan Gi, and I. A. Shelaev 1966 17 p refs In RUSSIAN
(JINR-P-2854)

The influence of azimuthal displacement of the ion source on the acceleration process in 150 and 300 cm cyclotrons is studied. It is shown that lengthening of the first half revolution by 20° decreases the spread in orbit centers, and, hence, the spread in energy, which allows one to make the extraction more effective. The position of the ion source with respect to the magnetic center of the accelerator and the electrode geometry of the central region are determined. Author (NSA)

N67-17693# Oak Ridge National Lab., Tenn. Neutron Physics Div.
CALCULATIONS OF THE TRANSPORT OF NEUTRONS FROM FISSION AND 14-MeV POINT SOURCES IN AN INFINITE MEDIUM OF AIR
E. A. Straker 9 Aug. 1966 19 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1547) CFSTI: HC$3.00/MF$0.65

Calculations by various investigators of first-collision doses and energy spectra due to neutrons from fission and 14-MeV point sources in an infinite medium of air are compared with each other and with Monte Carlo and discrete-ordinate calculations. In the Monte Carlo calculations for the 14-MeV source, the sensitivity of the dose and spectral results to the manner in which inelastic scattering was treated in the calculations was investigated. It is concluded that the significant differences in the calculated doses and energy spectra for both fission and 14-MeV sources cannot be traced to differences in the calculational techniques sections alone, but that they may be due to variations in the cross sections used in the calculations. Varying the treatment of inelastic scattering led to wide variations, indicating the importance of obtaining accurate inelastic cross-section data. Author (NSA)

N67-17694# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
BOILING WATER REACTOR STABILITY STUDIES Quarterly Report, 1 Jan.–31 Mar. 1966
Hoeld 31 Mar. 1966 28 p refs Sponsored by US-EURATOM Joint Res. and Develop. Program
(EUR-2821; EURAEC-1608; QR-5)

As part of the current series of measurements being carried out, the stationary local steam bubble content and frequency range output—local steam bubble content were determined at three different positions along the boiling zone of the annulus test section of the AEG instability testing rig, and under a series of different test conditions. After overcoming a few running-in difficulties, caused by the length of time during which the testing rig had been at a standstill, it was possible to carry out the first third of the measurement program envisaged. The evaluation of the measurement data was effected with the help of a computer program. A part of the measurement results is reproduced in the form of tables and diagrams. A computer program, which was developed for the IBM 7040 digital computer from the analytical model adapted to the data of the testing rig during previous report periods, has been named AMOK-L. This program is intended to make it easier in the future to analyze theoretically the experimentally found frequency ranges. Author (NSA)

N67-17695# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
BARYON-BARYON FORWARD SCATTERING AND COLLINEAR SYMMETRIES [BARION-BARIONNOE RASSEYANIE VPERED I KOLLINEARNYE SIMMETRII]
P. Winternitz and A. A. Makarov 1966 7 p refs In RUSSIAN Submitted for Publication
(JINR-P-2872)

Relations between total cross sections for scattering from singlet and triplet states following from the collinear [SU(3) ⊗ SU(3)] symmetry, are obtained for baryon-baryon scattering. Author (NSA)

N67-17755# Stockholm Univ. (Sweden). Inst. for Theoretical Physics.
[GENERAL RELATIVITY AND QUANTUM THEORY] Final Scientific Report, 1 Feb. 1965–31 Aug. 1966

Bertel Laurent 3 Oct. 1966 5 p
(Contract AF 61(052)-865)
(AFOSR-66-2699; AD-642797) CFSTI: HC $3.00/MF $0.65

A new method to produce gravitational radiation by stimulated emission, using photons as the stimulating particles, is suggested. Such a process should occur in some stars, and it has important possibilities in connection with gravitational lasers. Calculations show that soft gravitational radiation could interact with light more than has hitherto been assumed. The mixed Compton effect and the behaviour of superconductors in gravitational fields were also studied as well as a generalization of the 5 dimensional theory to account for PC-nonconservation. Author (TAB)

N67-17758 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF WIDENING AND DISPLACING ENERGY LEVELS [K VOPROSU OB USHIRENII I SDVIGE ENERGETICHESKIKH UROVNEY]
Y. I. Grigor'yev 7 Dec. 1966 13 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 4, 1964 p 56–61
(FTD-HT-66-277; TT-67-60211; AD-643633) CFSTI: HC $3.00

The normalization method is used for obtaining finite expressions for displacing and widening energy levels at transitions of an arbitrary form. This report pursues the construction of an apparatus with an arbitrary number of particles in initial and final states, suitable during the investigation of processes and the evaluation of how the renormalization method can be used in the given problem for the exclusion of divergences. A Schroedinger representation is used in the equation. An S-matrix is broken into a sum of normal derivatives which corresponds to various physical processes, matrices of transition. The perturbation method was used during the obtaining of a certain factor. A second approximation analysis within the frames of any staircase approximation is cited. The realization method used does not propose an invariable use of any concrete approximations, therefore it allows us to obtain the final expressions for the displacement and width of energy levels in an arbitrary approximation. The formulas are valid in case of a spontaneous as well as forced irradiation. They can be accepted for processes with any number of particles in the initial state. The covariance of formulation can be useful in relativistic ...ns. A concrete selection of the initial state vector also ...termines the selection of this or any other physical problem. Author (TAB)

N67-17773*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
VARIATIONAL METHODS AND DEGENERATE PERTURBATION THEORY
Saul T. Epstein 29 Dec. 1965 20 p Submitted for Publication
(Grant NsG-275-62)
(NASA-CR-70027; WIS-TCI-143) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Variational methods related to degenerate perturbation theory are discussed in a general way through second order in the energy and first order in the wave function. Author

N67-17774*# Alabama Univ. Research Inst., Huntsville.
THEORETICAL PHOTODETACHMENT CROSS SECTION FOR THE NEGATIVE ATOMIC OXYGEN ION
H. J. Jackson, Jr. and W. R. Garrett Dec. 1965 61 p refs
(Grant NsG-381)
(NASA-CR-69848; UARI-32) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The theoretical photodetachment cross section for the negative atomic oxygen ion in its normal ground state, has been investigated for the three transitions and in the photon energy range up to 12 ev. In addition, the scattering cross section for the neutral oxygen atom, the polarizability, the attachment cross section and the attachment coefficient have also been determined. Results are compared with available experimental and other theoretical data. Excellent agreement has been obtained with the latest reliable experimental data. The Hartree–Fock treatment utilizing a modified form of the Slater approximation for exchange was used to compute the bound state radial functions for the neutral atom and negative ion. The polarization potential was developed from first order perturbation theory in conjunction with the adiabatic approximation. The continuum wave functions for the outgoing electron were derived from Schrödinger's equation utilizing the modified Hartree–Fock–Slater and polarization potentials. The agreement of the photodetachment and neutral atomic oxygen cross sections with experimental data as well as the agreement of the polarizability calculation with experiment is a most favorable indication for the validity of this work. Author

N67-17775*# Nevada Univ., Reno.
CONFIGURATION INTERACTION IN THE HELIUM CONTINUUM
P. L. Altick and E. Neal Moore [1965] 32 p refs
(Grant NGR-29-001-008)
(NASA-CR-71233) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Configuration interaction is applied to the 1P helium continuum between the first and second quantum thresholds. Discrete configurations are included which give rise to autoionization levels (resonances). Differential oscillator strengths are presented for the nonresonant region, while positions, widths, and q values are given for the six lowest lying resonance levels. Author

N67-17778* Wisconsin Univ., Madison. Theoretical Chemistry Inst.
THE THEORY OF ATOMIC COLLISIONS
Donald Kouri 30 Jul. 1965 240 p refs
(Grant NsG-275-62)
(NASA-CR-69990; WIS-TCI-112) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The separation of the rotational degrees of freedom from the N particle Schrödinger equation is discussed and applied to the system H^+–H. A symmetric definition of the Euler angles is employed thus facilitating the inclusion of the effects of the Pauli principle due to the identity of the protons. The solutions of the coupled partial differential equations which are obtained are expanded in terms of Born–Oppenheimer H_2^+ electronic wave functions and the resulting coupled equations investigated. A selection rule restricting the coupling to states of a single symmetry is derived and the asymptotic behavior of the coupled differential equations considered. Next a truncation scheme for treating the coupled equations is presented. Author

N67-17783*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE MOESSBAUER EFFECT AND ITS APPLICATION TO MEASURING TECHNOLOGY
Helmut G. Lackner *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 1–27 refs (See N67-17781 07-14)
GPO: HC $3.00/MF $0.65

The physics of the Mossbauer effect is discussed, and its significance in solving different problems of measuring technology is assessed. It is pointed out that the extremely sharp line and the ability to determine the profile of a gamma line makes it an

attractive technique for measuring the interactions of the surrounding electrons and of the external fields with the nuclei. This is possible because the linewidths encountered are small compared with the characteristic energies involved. Three important phenomena associated with nuclear hyperfine structure are considered: the isomer shift, the quadrupole splitting, and the nuclear Zeeman effect. A calibration technique using the Mossbauer effect is described; this deals with vibration measurements and calibration of vibration transducers. Three general cases are studied: partial resonance, off resonance, and resonance. A theoretical method for utilizing each case was generated and experimentally tested. M.G.J.

N67-17855*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

NUMERICAL EVALUATION OF BARRIER PENETRATION AND RESONANCE EFFECTS ON PHASE SHIFTS

R. B. Bernstein, C. F. Curtiss, S. Imam-Rahajoe, and H. T. Wood 27 Dec. 1965 36 p refs Submitted for Publication
(Grant NsG-275-62)
(NASA-CR-69590; WIS-TCI-133) CFSTI: HC $3.00/MF $0.65 CSCL 20J

Quantum mechanical calculations are presented showing the dependence of the reduced phase shift, η^*, on the quantum parameter, Δ^*, for a fixed reduced effective potential and various reduced energies, E^*. The observed oscillatory behavior of $\eta^*(\Delta^*)$ is due primarily to the inclusion of the physically unimportant contribution of $M\pi$ to the phase shift, where M is the number of quasi-bound (virtual) states of energy less than E^*. A modified reduced phase shift, η^*, defined by excluding this contribution, displays only the sharp inflections associated with barrier penetration under resonance conditions. Except for the resonance contribution, the phase shifts may be accurately reproduced by a second-order JWKB procedure. This method also accurately predicts the resonant energies (i.e. the energies of the quasi-bound states). The first-order JWKB treatment of the barrier penetration problem suffices for estimating the level widths and lifetimes of the virtual states as well as the main features of the resonant phase shifts, but does not accurately reproduce the quantal calculations. Author

N67-17863*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE SPECTRUM OF INVERSE COMPTON SCATTERED PHOTONS

Frank C. Jones Aug. 1966 47 p refs Submitted for Publication
(NASA-TM-X-55804; X-641-66-379) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The scattered photon spectrum arising from an electron moving in an isotropic, monoenergetic radiation field is calculated in a simple approximation and exactly. A comparison of the two results indicates that for electrons with $E/mc^2 > 10$ the approximation is very useful. In astrophysical applications this spectrum is often approximated by a delta function. This approximation is examined and those conditions are found under which this approach yields valid results. Author

N67-17870*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.

RED-SHIFT ARISING FROM LIGHT PASSAGE IN A MAGNETIC FIELD Semiannual Report

Louis Gold Jan. 1966 18 p refs
(Grant NGR-31-003-032)
(NASA-CR-71111; SIT-P117(1/66)) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Proposed is a stimulated photon-photon scattering model for the interaction of the red-shift of light in transit through a magnetic field, that replaces the magnetic field by an effective radiation field associated with cyclotron resonances. Calculations on the photon density required to simulate the strength of the prevailing magnetic field show that the contributions of each cyclotron resonance to the stimulated cross section falls off faster than $1/n$ where $n = 0,1,2,3...$ for the diverse discrete frequencies. The scheme offers a first description of n_1 to at least determine the form of its behavior. G.G.

N67-17888# California Univ., Livermore. Lawrence Radiation Lab.

ASTRON MECHANICAL ENGINEERING DESIGN EFFORT

Charles A. Hurley 23 Sep. 1966 10 p Presented at the Symp. on Eng. Probl. of Controlled Thermonucl. Res., Gatlinburg, Tenn., 3-5 Oct. 1966 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-70027; CONF-661016-8) CFSTI: HC $3.00/MF $0.65

The mechanical engineering effort on the ASTRON program is separated into three categories. The first of these is the support of the existing experimental apparatus. Concurrent with this, are the design and construction of the new main chamber, and the new 4-MeV induction accelerator. These efforts are described. NSA

N67-17893# Joint Inst. for Nuclear Research, Dubna (USSR).

DETERMINATION OF THE PARAMETERS OF A CHARGED PARTICLE MOVING IN A STOPPING SCATTERER PLACED INTO A INHOMOGENEOUS MAGNETIC FIELD BY THE MAXIMUM LIKELIHOOD METHOD [OPREDELENIE METODOM MAKSIMUMA PRAVDOPODOBIYA PARAMETROV ZARYAZHENNOI CHASTITSY, DVIZHUSHCHEISYA V TORMOZYASHCHEI RASSEIVAYUSHCHEI SREDE, POMESHCHENNOI V NEODNORODNOE MAGNITNOE POLE]

G. A. Emel'yanenko, K. P. Lomov, G. I. Makarenko, V. I. Moroz, I. S. Saitov et al 1966 41 p refs In RUSSIAN
(JINR-P-2829)

The maximum likelihood method is used to determine the initial momentum and angles of a nonradiating particle moving in stopping and scattering matter placed in an inhomogeneous magnetic field. Stopping and multiple scattering of the particle, as well as the inhomogeneity of the magnetic field are studied simultaneously. Author (NSA)

N67-17895# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

THE DECAY $^{155}Tb \rightarrow ^{155}Gd$

M. Finger, P. Galan, M. Kuznetsova, Ya. Liptak, Ya. Urbanets et al 25 Aug. 1966 8 p refs
(JINR-E-2908)

The energies and intensities of γ-ray transitions from the decay of $^{155}Tb \rightarrow ^{155}Gd$ were measured with a double-focusing β spectrometer and with a Ge(Li) semiconductor detector. The multipolarities are given and a more complete decay scheme is constructed. The admixture of E0 transitions from the odd-parity rotational band based on the level at 592 keV to the levels of the ground state band seems to indicate the vibrational nature of this level. Author (NSA)

N67-17896# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

DESIGNING OF MAGNETIC SYSTEM OF RELATIVISTIC CYCLOTRON ELECTRON MODEL [RAZRABOTKA MAGNITNOI SISTEMY ELEKTRONNOI MODELI RELYATIVISTSKOGO TSIKLOTRONA (EMRTS)]

S. B. Vorozhtsov, N. L. Zaplatin, V. S. Rybalko, and L. A. Sarkisyan 2 Apr. 1966 24 p refs In RUSSIAN
(JINR-P-2852-1)

The designing of the magnetic system of the 700-MeV relativistic cyclotron electron model intended for the experimental investigation of the modified resonance method of particle extraction is discussed. Author (NSA)

N67-17898# California Univ., Livermore. Lawrence Radiation Lab.
ANALOG COMPUTER STUDY OF CURRENT RISE TIME IMPROVEMENTS FOR 2X CAPACITOR BANK
David J. Edson 23 Sep. 1966 22 p Presented at the Symp. on Eng. Probl. of Controlled Thermonucl. Res., Gatlinburg, Tenn., 3–5 Oct. 1966 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-70034; CONF-661016-7) CFSTI: HC $3.00/MF $0.65

The possibility of decreasing the current rise-time of an existing capacitor bank/quadrupole load coil combination by the addition of high-frequency, harmonically related energy storage sections was studied. An approach was found in which the LARC computer was used to obtain attenuator settings for a PACE analog computer, used for solving the differential equations. Detailed adjustments of the current wave shape were possible with this approach. Author (NSA)

N67-17900# California Univ., Berkeley. Lawrence Radiation Lab.
ANGULAR DISTRIBUTIONS OF GAMMA RAYS EMITTED IN ^{197}Au(p,2n)^{196}Hg AND ^{197}Au(p,4n)^{194}Hg REACTIONS
T. Yamazaki and D. L. Hendrie Jul. 1966 9 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 12–17 Sep. 1966
(Contract W-7405-ENG-48)
(UCRL-16987; CONF-660906-28) CFSTI: HC $3.00/MF $0.65

A study of angular distributions of gamma rays from the ^{197}Au(p,2n) and ^{197}Au(p,4n) reactions has established levels of ^{196}Hg and ^{194}Hg and determined the level spins and transition multipolarities as follow (energy in keV): 425, 2+; 1035, 2+; 1060, 4+; 1755, 5–; 1785, 6+ in ^{196}Hg, and 426, 2+; 1061, 4+; 1795, 6+; 1808, 5–; 1907, 7– in ^{194}Hg. Author (NSA)

N67-17915# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
A PERTURBATION CALCULATION OF THE ENERGY OF THE FIRST EXCITED STATE ($2p\sigma$) OF H_2^+
Robert Silbey 22 Sep. 1966 12 p refs
(Grant AF-AFOSR-149-65)
(WIS-TCI-192; AD-643251) CFSTI: HC $3.00/MF $0.65

A perturbation calculation to third order in energy was previously carried out by Matcha, Lyon, and Hirchfelder on the ground state of H2(+) starting with a simple zeroth order function. In this note, a similar calculation is presented on the 2p sigma state of H2(+). In this calculation, the first order perturbation equation is solved, and the energy calculated to third order. Author (TAB)

N67-17923# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
INTERPOLATION OF THE WAVE FUNCTIONS IN THE ANGULAR MOMENTUM PLANE [INTERPOLATION DES FONCTIONS D'ONDE DANS LE PLAN COMPLEXE DU MOMENT ANGULAIRE]
Pierre C. Sabatier Nov. 1966 8 p refs In FRENCH; ENGLISH summary
(TH/170) CFSTI: HC $3.00/MF $0.65

Interpolation formulas for the wave functions in the λ complex plane are derived in the case of a potential analytic and even in a circle centered at $r = 0$. Author

N67-17936* Polish Academy of Sciences, Cracow. Inst. of Nuclear Research.
CENTRAL COLLISIONS OF NUCLEONS WITH HEAVY NUCLEI FOR ENERGY HIGHER THAN 10^{12}eV
R. Holynski, S. Krzywdzinski, and M. Miesowicz Jul. 1966 400 p refs Submitted for Publication
(INR-737/VI/PH) CFSTI: $3.00

The 220 interactions originated by singly charged or neutral particles of the energy above 10^{12} eV were analysed. The analysis was performed in six groups of events defined by multiplicity n_s and number of evaporation tracks N_h. Angular distributions of secondaries, distributions of anisotropy parameter σ, distributions of bimodality parameter D, σ–D correlation and distributions of inelasticity coefficient K were also studied. For central collisions between nucleons and heavy nuclei these collisions were selected by criteria of $N_h > 8$ and $n_s \geq 30$ a model was proposed. In the model these collisions are treated as a superposition of the elementary nucleon-nucleon collisions. Author

N67-17944# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
SOME NEUTRON MEASUREMENTS WITH SIMULATED ING TARGETS
J. Walker Jun. 1966 56 p refs
(AECL-2635) CFSTI: HC $3.00/MF $0.65

Thermal neutron fluxes in the vicinity of a simulated Intense Neutron Generator (ING) target have been measured using Mn and Au foils, and a small BF_3 detector. The target was a Pb cylinder either 4" or 8" in diameter with a 1.2 g Ra–Be neutron source at its centre. This was centrally mounted in a 5' diam.×5' high tank which was filled with either H_2O or D_2O moderator. Various gaps and absorbing annuli were placed around the target, and air-filled aluminum beam tubes were mounted radially or tangentially from the target to simulate typical ING conditions. The measured thermal neutron fluxes were less than calculated at all radii. The single-age computation clearly gives large errors at large radii, but the multi-energy approach seems to give a useful indication of the thermal flux distribution in spite of the extreme simplicity of the model. The fall in measured fluxes at small radii in both D_2O and H_2O is most likely caused by absorption in the target material which is not allowed for in the computational model. Author

N67-18166*# Princeton Univ., N. J. Dept. of Astrophysical Sciences.
NEW INTERPRETATION OF THE $^1\Sigma_u$ AND $^1\Pi_u$ RYDBERG STATES AND VALENCE STATES OF NITROGEN BELOW THE FIRST IONIZATION LIMIT
Kurt Dressler Jan. 1967 4 p Presented at the Intern. Conf. on Spectry., Bombay, Jan. 1967
(Grant NsG-414)
(NASA-CR-81777) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A new interpretation of Rydberg and valence states of Nitrogen is presented which explains previous difficulties of interpretation of experimental data. Configuration interaction accounts for observed complexity. The correlation between the observed (perturbed) levels of Nitrogen 14 and the deperturbed vibrational levels of valence and Rydberg states is tabulated. A.B.

N67-18195*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SCATTERING OF ELECTRONS BY ATOMIC SYSTEMS WITH CONFIGURATIONS $2p^q$ AND $3p^q$

Kenneth Smith, R. J. W. Henry, and P. G. Burke [1965] 28 p refs
(NASA-TM-X-57271; TP-213) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The theory is developed describing transitions induced by electron impact between all the ground state terms of atoms and ions with configurations $(2p)^q$ and $(3p)^q$. Full account is taken of exchange and the computed cross sections satisfy exactly the required unitarity bounds. A description is given of the method used for the solution of the resultant coupled integro differential equations. Author

N67-18200*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXCITATION OF HYDROGEN MOLECULE BY ELECTRON IMPACT. III–SINGLET-TRIPLET EXCITATIONS
S. P. Khare Nov. 1966 20 p refs
(NASA-TM-X-59172; X-640-66-514) CFSTI: HC $3.00/MF $0.65 CSCL 20H

One-center wave functions of Huzinaga along with the Ochkur approximation were employed to investigate the exchange excitation of the hydrogen molecule by electron impact from the ground electronic state $x(1s\delta^1\Sigma_g^+)$ to the triplet $a(2s\delta^3\Sigma_g^+)$, $b(2p\delta^3\Sigma_u^+$ and $c(2p\pi^3\Pi_u^3)$ electronic states. Since the lowest triplet state $b(^3\Sigma_u^+)$ is a repulsive state and the intercombination of the triplet and the singlet states are optically forbidden, the singlet–triplet excitations give rise to the dissociation of the hydrogen molecule into two hydrogen atoms. The shape of the theoretical curve for the dissociation cross section is in general accord with the experimental data of Corrigan. Theoretical efficiencies of the dissociation of the hydrogen molecule by electron impact and of the emission of the continuous radiation due to $a(^3\Sigma_g^+)\rightarrow b(^3\Sigma_u^+)$ transitions have also been computed and are compared with the available experimental data. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-16824# Polytechnic Inst. of Brooklyn, N. Y.
RESEARCH ON ELECTROMAGNETICS FOR PROJECT DEFENDER Semiannual Technical Summary Report, Period Ending 30 Sep. 1966
Rudolf G. E. Hutter 30 Sep. 1966 339 p refs
(Contract Nonr-839(38); ARPA Order 529)
(PIBMRI-1295.3-66; AD-642271) CFSTI: HC $3.00/MF $0.65

Research on several projects is described, with the general theme centering on the electromagnetic properties of ionized gases and/or plasmas, and gas flow problems. Studies are also included on the synthesis and characterization of polymeric ablation materials, and the electrochemical behavior of oxide films on semiconductors. For individual abstracts, see N67-16825 through N67-16858. M.G.J.

N67-16826# Polytechnic Inst. of Brooklyn, N. Y.
RESISTIVE INSTABILITIES IN A TOROIDAL PLASMA
K. Stuart *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 5–21 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Experimental and analytical studies of resistive instabilities in a toroidal plasma are presented. The experimental data was obtained from a hydrogen plasma, with the plasma structures consisting to two, three, and five filaments. Equations obtained by Furth, Killeen, and Rosenbluth are derived with radial plasma motion incorporated in order to better approximate the plasma behavior. A numerical analysis of this problem was made to provide a quantitative fit to experimental data. The data shows growth rate versus wavelength of the instability and growth rate versus conductivity of the plasma to have the proper qualitative behavior. C.T.C.

N67-16828# Polytechnic Inst. of Brooklyn, N. Y.
AN EXPERIMENTAL STUDY OF MICROWAVE HEATING IN THE HELIUM AFTERGLOW
H. M. Cronson *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 23–32 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Two related aspects of microwave heating are investigated experimentally. In the first, spatial variations of electron temperature in a standing wave are deduced from changes in afterglow light intensity during a microwave pulse. In the second, the temperature dependence of the recombination coefficient is studied over a pressure range from 0.75 to 68 torr. For a fixed incident power level the variation of intensity ratio along the plasma guide terminated by a short circuit was examined. Graphs are included of the normalized data, and it is noted that these show good agreement with theory. C.T.C.

N67-16829# Polytechnic Inst. of Brooklyn, N. Y.
SCREEN ANODE DISCHARGE
H. Farber and G. Louie *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 32–42 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

A study was made of the variation of electron density with the variation of operating conditions in the screen anode discharge. The apparatus consisted of connecting the screen as an anode instead of as a cathode with a plasma resulting which has additional desirable features. The new discharge will provide a plasma electromagnetic wave interaction structure with a free plasma boundary. The measurements consisted of plasma wall potential and electron density. It is reported that an experiment was also performed to determine if the inflection point determination of the plasma potential agrees with a previously derived equation for positive ion saturation current collection. C.T.C.

N67-16830# Polytechnic Inst. of Brooklyn, N. Y.
LOW TEMPERATURE EXPANSION OF THE BOLTZMANN EQUATION
G. Dorman *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 42–44 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Relative to making predictions of the behavior of complex plasma systems, it is reported that the full Boltzmann equation is being investigated in the low temperature region. A comparison is made between results from this expansion and results of a resonance oscillation theory in which only the first two moment equations of the Boltzmann equation are used. C.T.C.

N67-16831# Polytechnic Inst. of Brooklyn, N. Y.
PLASMA SHEATH STUDIES
H. Friedman and T. Koga *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 45–54 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

The most general sheath equations are investigated and cast into a phase plane formalism. Matching the sheath to the plasma solution in the asymptotic sense yields two results: (1) all

constants of integration are evaluated and (2) the minimum velocity with which the electrons and ions may enter the sheath regime is established. The latter result fixes the temperature to which the discharge must adjust if a steady state configuration is to be reached. This is a rigorous confirmation of the Bohm ion entrance velocity criterion, and adherence to this criterion will assure a monotonic potential distribution in the sheath. Conclusions are that the requirement of real solutions in the boundary layer sheath forces the discharge temperature to adjust so that the turning point of the plasma velocity curve reaches the wall. This is equivalent to adding to the quasi-neutral plasma solution the boundary condition which requires that the velocity at the plasma sheath interface be the ambipolar sound velocity. C.T.C.

N67-16837# Polytechnic Inst. of Brooklyn, N. Y.
ELECTRON-BEAM-PLASMA INTERACTION
P. E. Serafim and F. T. Stone *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 98–101 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

A survey of activities involved with theoretical studies of an electron beam-plasma-metallic waveguide system is presented. These activities are divided into the following research problems: (1) direct approach to the formulation of the exact dispersion diagram and the field analysis for the case of a circular cylindrical metallic waveguide partially filled with a temperate plasma, (2) a quasistatic solution for this configuration, (3) a dispersion diagram for the complete system, (4) a direct approach to the formulation of the exact dispersion diagram and field analysis, and (5) effects of nonequilibrium plasma electron temperature (T_e) and plasma ion temperature (T_i), where $T_e >> T_i$. C.T.C.

N67-16838# Polytechnic Inst. of Brooklyn, N. Y.
RADIATION IN AN INHOMOGENEOUS UNIAXIAL MEDIUM
H. J. Stalzer and J. Shmoys *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 101–113 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

In order to investigate the effect that curvature of the magnetic field has on the propagation of electromagnetic waves in the ionosphere, a two dimensional canonical problem containing the essential features of the earth's ionosphere is formulated. Main concern is given to a cold plasma where the electron density is essentially uniform and the magnetic field is curved. The frequency of the electromagnetic waves is assumed much less than the cyclotron frequency, and the magnetic field is taken to be $\underline{B}_0 = \underline{\rho}_0 B_0$ in a cylindrical coordinate system. The medium is approximated by a cold lossless plasma of uniform electron density, and the signal strength is assumed small enough to allow a linear approximation of the dynamic equations. The effect of the magnetic field and the electrons in the ionosphere are then encompassed in a dielectric dyadic whose matrix representation is diagonal. C.T.C.

N67-16839# Polytechnic Inst. of Brooklyn, N. Y.
CERENKOV RADIATION IN CAVITIES
R. Sasiela *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 114–121 ref (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

An expression was previously found for the energy in each of the resonant modes of a plasma filled cylindrical cavity of length Z_0 and radius R when an electron moving with velocity v passed through it. Relative to this an investigation was made of how much of this energy was due to each of the three sources–Cerenkov radiation, radiation from entering and leaving the cavity, and the interaction of this radiation with the cavity walls which would subsequently influence the electron. In particular, a determination was made to see if the last two effects could be made small compared to the Cerenkov radiation. It was found that the only effect to consider is the interaction caused when the fields of the electron are reflected from the walls and then interact back upon the particle. This problem is treated by the method of images for both the dielectric and plasma case. C.T.C.

N67-16840# Polytechnic Inst. of Brooklyn, N. Y.
EXPERIMENTAL WORK (IN CONNECTION WITH CERENKOV RADIATION)
R. Pepper *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 121 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Continuing work on improving the signal to noise ratio in measurements made with a rebatron and on improving measurements with a waveguide coupler is reported. C.T.C.

N67-16841# Polytechnic Inst. of Brooklyn, N. Y.
PLASMA FOR EXPERIMENTS ON CERENKOV RADIATION
G. Ott *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 122–127 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

A method of producing a nearly uniform plasma in a microwave cavity and of passing a high energy pulsed electron beam from a rebatron source through the plasma is presented. The apparatus consists of a copper walled cavity, two microwave ports, and a pulse discharge in which high electron densities can be achieved without breakdown. Pulses of ≈ 30 μs with repetition rates ≈ 100 cps and voltages up to 15,000 volts are available. The measurement of electron density variation during the pulse is achieved by monitoring, on a scope, the reflected microwave power from the cavity at various input frequencies over the duration of the pulse and the afterglow. The validity of this technique is based on the fact that the power reflected from the cavity is a minimum at a resonant frequency of the cavity. Thus a variation of reflected power over the pulse indicates either a change from a resonant condition to a non-resonant condition or vice-versa. Diagrams and schematics are included for the cavity, the configuration for generating and monitoring the discharge, and measurement of the reflected power. C.T.C.

N67-16842# Polytechnic Inst. of Brooklyn, N. Y.
TRANSITION RADIATION
E. Ott and J. Shmoys *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 127–137 ref (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Consideration is given to the phenomenon of transition radiation which is produced when a charge crosses the boundary between two regions with different electrical properties. The problem is illustrated, and shows a line charge (of charge Q per unit length) moving with a constant velocity v and crossing a boundary between two dielectrics at the time t=0. The dielectric constant is ϵ_+ for $z>0$ and ϵ_- for $z<0$. The magnetic permittivity is μ_+ for $z>0$ and μ_- for $z<0$. The velocity is assumed to be less than the speed of light in both media. C.T.C.

N67-16843# Polytechnic Inst. of Brooklyn, N. Y.
TRANSITION RADIATION AND THE CERENKOV EFFECT
E. Ott and J. Shmoys *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 138–150 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

When a charge crosses the boundary between two regions with different electrical properties a burst of electromagnetic energy is radiated. This phenomenon is called transition radiaton, and consideration is given to the problem of what happens when a line

charge moves with a velocity greater than the speed of light in either one or both of the media. The following cases are investigated: (1) the charge goes from a medium in which it produces no Cerenkov radiation to a medium in which it does, (2) a charge producing Cerenkov radiation crosses into a region in which it produces no Cerenkov radiation, and (3) the charge produces Cerenkov radiation in both media. C.T.C.

N67-16844# Polytechnic Inst. of Brooklyn, N. Y.
TRANSITION RADIATION IN PARALLEL PLATE WAVEGUIDE
I. Haber and J. Shmoys *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 150–159 *ref* (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Progress is reported in work aimed at measuring the transition radiation resulting from a beam shot through a plasma slab in a parallel plate waveguide. The expected radiation characteristics are derived for a half space and a slab, and the results are compared to those obtained in a free space geometry. C.T.C.

N67-16845# Polytechnic Inst. of Brooklyn, N. Y.
RADIATION AND SCATTERING PROBLEMS IN COMPRESSIBLE PROBLEMS–SOLUTIONS BY RAY OPTICS
L. B. Felsen and F. M. Labianca *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 159–171 *refs* (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65
(Contract AF 19(628)-2357)

A ray-optical approach is directly applied to a general class of boundary value problems involving compressible plasmas. The procedure is a generalization of the geometrical theory of diffraction in compressible plasmas, and it is shown that the results agree with those derived by a rigorous technique for various special geometrics. Assumptions are that the medium is a homogeneous, isotropic plasma which may be described by a one-fluid (linearized) model in which the electrons are considered mobile and are characterized by a finite temperature. The ions are taken to be stationary by virtue of their greater mass, and produce a neutralizing background. Collisions between electrons and other particle species are neglected, and only two dimensional problems are treated. C.T.C.

N67-16849# Polytechnic Inst. of Brooklyn, N. Y.
PHOTOIONIZATION OF OXYGEN AS A POSSIBLE MECHANISM FOR THE OBSERVED PRECURSOR PHENOMENON AHEAD OF ARGON SHOCKS
D. S. Wilson, T. Lin, and S. Lederman *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 197–200 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

An attempt to explain precursor ionization ahead of argon shocks as a one-step photoionization of O_2, present as an impurity in the argon, is briefly discussed. The calculation was based on known photo cross-section data at the ionization edge of O_2, with only the major absorption lines used. The results of this calculation, and calculations made at other initial pressures of O_2 are shown graphically. C.T.C.

N67-16850# Polytechnic Inst. of Brooklyn, N. Y.
LANGMUIR PROBE AND MICROWAVE DIAGNOSTICS OF IONIZED SHOCK TUBE FLOW
S. Lederman, D. S. Wilson, and E. F. Dawson *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 200–208 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

A summary is presented of a method of measuring electron number densities behind the incident shock wave in a pressure driven shock tube by a microwave resonant cavity technique and by electrostatic probes. The driven gas was air at initial pressures of 0.5 and 1.0 mm Hg, and the shock Mach number was varied from 7 to 10. By measuring the shift in resonant frequency and the change in Q of the cavity when the plasma filled the cavity, both the electron number density and electron neutral collision frequency of the plasma were determined. A major conclusion of the experiment is that the reduction of the data using the free molecular theory of Laframboise yields values for the free stream electron number densities which are in agreement with independent resonant cavity measurements. C.T.C.

N67-16852# Polytechnic Inst. of Brooklyn, N. Y.
RESONANT CAVITY TECHNIQUES FOR MEASUREMENT OF ELECTRON DENSITY AND COLLISION FREQUENCY OF HYPERSONIC FLOWS
J. E. W. Griemsmann, D. Jackenko, E. Malloy, and S. Lederman *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 209–213 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Resonant microwave cavity techniques used for plasma diagnostics of the hypersonic flow of low density gases in various shock tube and shock tunnel facilities are discussed. Developments are reported in instrumentation for time resolved measurements of electron density, and construction and testing of a smooth bore cavity for measuring low electron density in large shock tunnels are mentioned. C.T.C.

N67-16854# Polytechnic Inst. of Brooklyn, N. Y.
DYNAMIC MICROWAVE BREAKDOWN EXPERIMENTS IN LOW PRESSURE AIR
J. W. E. Griemsmann, D. Jacenko, and E. Malloy *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 214–222 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

The spatial progress of ionization in low pressure gases subjected to sufficiently high microwave radiation was studied to determine the processes responsible for breakdown at high altitudes. Experiments were conducted in a glass lined circular waveguide fitted with direct current discharge electrodes at its far end. These electrodes enabled specification of the place at which a relatively high electron density would be present and thus specify the point of initial avalanche build up or breakdown. The following behavior was found in the response of the system to increasing microwave pulsed power levels. With the electrodes not excited, several kilowatts peak power of 2 μ sec pulses was found necessary to cause breakdown. With assumed breakdown on repeated pulses the electrical breakdown responses were found to occur early in the pulse. With the dc ionizing source excited a range of breakdown conditions became evident. For a given pressure, a power threshold could be determined below which no evidence of breakdown appeared in the electrical responses. As the power increased evidence of breakdown first appeared at the trailing edge of the incident pulse; with further power increase the breakdown occurred at earlier times. C.T.C.

N67-16855# Polytechnic Inst. of Brooklyn, N. Y.
CAVITY AND LANGMUIR PROBE RAKE IN THE TUNNEL TEST SECTION: EXPERIMENTS OF ELECTRON DENSITY MEASUREMENTS IN 6 IN. SHOCK TUNNEL
M. H. Bloom and S. Lederman *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 222–240 refs (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65
(Grant NsG-409)

Experiments were conducted on plasma effects around bodies in the nozzle of a hypersonic shock tunnel under the following conditions: air as the test gas, Mach 13, density of 7.8×10^{-5}

atm, and static temperature of 140°K. Surveys of electron density were made by S-band microwave resonance cavities of the flow-through type, indicating a 20-inch diameter nondiffusive, uniform central core at a level of 8×10^8 electrons/cc. These correlate with the extent of the neutral boundary layer as determined by heat transfer measurements. Electron temperatures of 3000°K were measured by current probes and compared with the equilibrium supply temperature of 3900°K. On the basis of independent ion current measurements with cylindrical probes in the range of probe diameters on the order of the Debye length, the currents are shown to exceed the values of a collisionless Laframboise theory based on a study by Berstein and Rabinowitz. The feasibility of making electron density profile surveys around bodies is demonstrated; and surface probe, ion current distributions around a blunt body are seen to correlate with neutral density distributions.
C.T.C.

N67-16956# Air Force Cambridge Research Labs., Bedford, Mass.
LABORATORY INVESTIGATIONS OF PLASMA INTERACTIONS WITH A DIPOLE MAGNETIC FIELD
Morton A. Levine and Allen C. Rubin *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. 1 1966 21 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

Bow shock formation and plasma trapping are alternative processes observed when a plasma streams into a magnetic dipole field. It is found that the breadth of the incoming plasma beam determines which process results. Author

N67-16997# ARO, Inc., Arnold Air Force Station, Tenn.
SPECTRAL CHARACTERISTICS OF A LOW DENSITY ARC-HEATED NITROGEN PLASMA
L. L. Price and W. K. McGregor Arnold Eng. Develop. Center, Oct. 1966 34 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-139; AD-640625) CFSTI: HC $3.00/MF $0.65

The visible and near ultraviolet spectrum from free jets of nitrogen plasmas produced by an arc-jet and exhausted into a low pressure (approx torr) test cell was photographed under varying conditions. The spectral characteristics were compared to the spectra obtained from argon plasmas produced in the same apparatus. The characteristics of the argon spectra have been attributed to the existence of long-lived, metastable argon atoms; the nitrogen spectral characteristics were found to be interpretable in a similar way. The spectrum consisted of N sub 2(+) (first negative) and N sub 2 (second positive) band systems, N atomic lines, and strong impurity radiation from OH, NH, and NO. The impurity bands can be explained on the basis of the ambient test cell gases which mix in the jet boundary and become excited by collision of the second kind with nitrogen atomic and molecular metastables. Several gases, chiefly argon, were mixed with the nitrogen in order to investigate the possible collisions of the second kind and thus determine the mechanisms responsible for the radiation. Several possible mechanisms are proposed in the report, but complete explanation must await further study. Author (TAB)

N67-17001# Columbia Univ., New York. Dept. of Electrical Engineering.
SURFACE WAVE GUIDING AND RADIATING SYSTEMS Final Report, Mar. 1963–Feb. 1966
S. P. Schlesinger Jun. 1966 60 p refs
(Contract AF 19(628)-2461)
(SR-95; AFCRL-66-482; AD-640813) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. PERTURBATION THEORIES FOR NONUNIFORM ELECTROMAGNETIC STRUCTURES S. L. Richter and P. Diament p 1–3 refs (See N67-17002 07-07)

2. FORMAL SOLUTION TO MAXWELL'S EQUATIONS FOR GENERAL LINEAR MEDIA P. Diament p 4 refs (See N67-17003 07-23)

3. DISPERSION RELATIONS FOR GENERAL ELECTROMAGNETIC PROPAGATING AND RADIATING STRUCTURES S. L. Richter p 5–6 (See N67-17004 07-07)

4. TRANSMISSION AND RADIATION PROPERTIES OF THE V-LINE P. Diament, S. L. Richter, W. L. Lupatkin, R. Rennick, and E. Rotholz p 7–9 refs (See N67-17005 07-07)

5. FERROELECTRICS AT MICROWAVE FREQUENCIES V. L. Granatstein, R. Rennick, B. Simmons, and P. Korn p 10–12 refs (See N67-17006 07-26)

6. PARAMETER SPACE MAPPING OF GUIDED ELECTROMAGNETIC WAVES ON A MAGNETO-PLASMA COLUMN V. L. Granatstein p 13–19 refs (See N67-17007 07-25)

7. PERTURBATION OF THE HOMOGENEOUS MAGNETO-PLASMAGUIDE V. L. Granatstein p 20 refs (See N67-17008 07-25)

8. OBSERVATION OF NON-QUASISTATIC PLASMA SURFACE WAVES V. L. Granatstein and P. Korn p 21–30 refs (See N67-17009 07-25)

9. WAVE PROPAGATION ALONG WARM PLASMA COLUMNS P. Diament and V. L. Granatstein p 31–34 refs (See N67-17010 07-25)

10. CORRELATION RADIOMETRY P. V. Bradford and T. C. Marshall p 35–37 refs (See N67-17011 07-25)

11. COMBINATION SCATTERING BY BERNSTEIN WAVES IN MAGNETIZED PLASMA A. Anastassiades and T. C. Marshall p 38–39 ref (See N67-17012 07-25)

N67-17007# Columbia Univ., New York. Dept. of Electrical Engineering.
PARAMETER SPACE MAPPING OF GUIDED ELECTROMAGNETIC WAVES ON A MAGNETO-PLASMA COLUMN
V. L. Granatstein *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 13–19 refs (See N67-17001 07-25) CFSTI: HC $3.00/MF $0.65

The specific boundary value problem considered was guided high frequency electromagnetic wave propagation along an axially magnetized air-bounded plasma of finite circular cross section. Three-dimensional parameter space maps were obtained, and three classes of waves were distinguished, each with a characteristic type of resonance and cutoff surface. The static modes exist in the low frequency regime and have zero frequency cutoff. Dynamic waves have a more complex behavior and have cutoff at a hybrid frequency. Surface waves are characterized by oscillation of surface charge and the concentration of field energy at the plasma–air interface, and are the most complicated. Resonance surfaces, divided into dispersion curve types, are discussed. N.E.N.

N67-17008# Columbia Univ., New York. Dept. of Electrical Engineering.
PERTURBATION OF THE HOMOGENEOUS MAGNETO-PLASMAGUIDE
V. L. Granatstein *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 20 refs (See N67-17001 07-25) CFSTI: HC $3.00/MF $0.50

It is reported that classical perturbation theory was applied to derive an expression for the first order correction to the dispersion curves to account for the effect of radial inhomogeneities in plasma density of the plasma confinement by a thin dielectric tube. The perturbation expression was applied to a symmetric surface mode

on an unmagnetized column, and comparison with results of a variational calculation indicated reliable results when the fractional frequency correction is less than 20%. N.E.N.

N67-17009# Columbia Univ., New York. Dept. of Electrical Engineering.
OBSERVATION OF NON-QUASISTATIC PLASMA SURFACE WAVES
V. L. Granatstein and P. Korn *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 21–30 refs (See N67-17001 07-25) CFSTI: HC$3.00/MF$0.65
Experiments designed to study the broadband surface wave propagation along an unmagnetized plasma column are described. Resonances of dipole surface mode were observed, and the Tonks–Dattner wave dispersion characteristics were investigated. Graphs of theoretical surface wave dispersion curves and experimental points, and output signal from scattering cavity versus time are presented. It was concluded that the experimental results show conclusive agreement with the nonquasistatic behavior predicted by the use of the full set of Maxwell's equations. N.E.N.

N67-17010# Columbia Univ., New York. Dept. of Electrical Engineering.
WAVE PROPAGATION ALONG WARM PLASMA COLUMNS
P. Diament and V. L. Granatstein *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 31–34 refs (See N67-17001 07-25) CFSTI: HC$3.00/MF$0.50
Experimental results from research on the dispersion relations for waves propagating along homogeneous, isotropic warm plasma columns surrounded by a dielectric medium are summarized. Contrast are drawn between warm and cold plasmas, large and small columns, and quasistatic and rigorous results. Analyses are reported (1) to show the effects of finite temperature on the cold plasma surface wave and to predict a new series of propagating modes above the plasma frequency, and (2) to show the transition between propagation at the speed of light and at the thermal speed. N.E.N.

N67-17011# Columbia Univ., New York. Dept. of Electrical Engineering.
CORRELATION RADIOMETRY
P. V. Bradford and T. C. Marshall *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 35–37 refs (See N67-17001 07-25) CFSTI: HC $3.00/MF $0.65
The building of a correlation radiometer, which consists of two low noise microwave receivers and a system for correlating their outputs, is reported. Information can be retrieved from the radiometer at the radio, infrared, and audio frequency levels. A cylindrical discharge column is being constructed in a large vertical magnetic field coil for experiments correlating the magnetoplasma with the radiometer. N.E.N.

N67-17012# Columbia Univ., New York. Dept. of Electrical Engineering.
COMBINATION SCATTERING BY BERNSTEIN WAVES IN MAGNETIZED PLASMA
A. Anastassiades and T. C. Marshall *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 38–39 *ref* (See N67-17001 07-25) CFSTI: HC$3.00/MF$0.65
Apparatus is briefly described with which Bernstein plasma waves will be investigated through detection of scattered microwaves. The discharge is a Penning ionization gauge, in which one of the cathodes is used as the electron gun. N.E.N.

N67-17073# Sandia Corp., Albuquerque, N. Mex.
A GENERALIZED MAGNETOHYDRODYNAMIC ENTRANCE FLOW MODEL. PART II: SERIES SOLUTION
W. S. Saric and K. J. Touryan Sep. 1966 32 p refs (Contract AT(29-1)-789)
(SC-RR-66-357) CFSTI: HC$3.00/MF$0.65
The hydromagnetic flow of a conducting, incompressible fluid is analyzed by using the two-conductivity model of Part I of this study. A power series solution is used in solving the problem rather than the momentum-integral method outlined in Part I. Author (NSA)

N67-17295# Miami Univ., Coral Gables, Fla. School of Environmental and Planetary Sciences.
PLASMAS IN GEOPHYSICS AND ASTROPHYSICS
Fred S. Singer *In* Md. Univ. Aerospace Eng. 1966 Sep. 1966 p 41–45 (See N67-17293 07-34) CFSTI: HC$3.00/MF$0.65
The importance of plasma physics in various physical problems ranging from the interior of the earth into the solar system and other galaxies is briefly reviewed. Some of the areas touched on include the presence of large electric currents in the ionosphere, their distribution, and their cause; electromagnetic induction in the earth's crust and mantle; propagation of radio whistlers and the phenomenon of micropulsations of the magnetic field; interaction of the solar wind with the geomagnetic field; the magnetohydrodynamics of the solar interior, the generation of sun spots, and the structure of a general magnetic field of the sun; and radio noise and cosmic rays. L.E.W.

N67-17303# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
NUCLEAR FUSION, VOLUME 6, NO. 1, 1966—SELECTED ARTICLES
Sep. 1966 83 p refs Transl. into ENGLISH from Nucl. Fusion (Vienna), v. 6, no. 1, 1966 p 1–5; 9–14; 24–40; 56–66 (AEC-TR-6673) CFSTI: HC$3.00/MF$0.65

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1. THERMAL RADIATION FROM AN INHOMOGENEOUS PLASMA LAYER V. V. Dolgopolov p 1–13 refs (See N67-17304 07-25)
2. THEORY OF THE HYDROCYNAMIC STABILITY OF INHOMOGENEOUS PLASMA FLUXES E. E. Lovetsky and A. A. Rukhadze p 14–25 refs (See N67-16305 07-25)
3. INSTABILITY OF A HOT CATHODE DISCHARGE IN A MAGNETIC FIELD AT LOW PRESSURES M. A. Vlasov, E. I. Dobrokhotov and A. V. Zharinov p 26–53 refs (See N67-16306 07-25)
4. PROBING A PLASMA BY ELECTROMAGNETIC WAVES Yu. N. Dnestrovsky and D. P. Kostomarov p 54–65 refs (See N67-17307 07-25)
5. INTERACTION OF FAST PLASMOIDS WITH MAGNETIC FIELD BARRIERS S. Chwaszczewski p 67–85 refs (See N67-17308 07-25)
6. POLARIZED PYROMETRIC PROBE: PRINCIPLES OF OPERATION AND MEASUREMENT OF PLASMA PARTICLE ENERGY R. Bardet and R. Geller p 86–93 refs (See N67-17309 07-25)

N67-17304# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
THERMAL RADIATION FROM AN INHOMOGENEOUS PLASMA LAYER
V. V. Dolgopolov *In its* Nucl. Fusion, Vol. 6, no. 1, 1966 Sep. 1966 p 1–13 refs (See N67-17303 07-25) CFSTI: HC $3.00/MF$0.65

This study discusses the radiation from an arbitrary inhomogeneous isotropic layer. With the fluctuation-theory method we obtain a formula for adiation intensity that depends on the solutions of two linear homogeneous second-order differential equations whose coefficients are determined by the distributions of density and temperature in the layer. We discuss in detail: 1) radiation from a semi-infinite homogeneous dielectric; 2) radiation from a layer with a smoothly changing dielectric permeability when the geometrical–optics method is applied; 3) radiation from a layer with a smoothly changing dielectric permeability when there are regions inside the layer in which the real portion of dielectric permeability vanishes and the geometrical–optics method is inapplicable owing to the smallness of the imaginary portion. Author

N67-17305# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
THEORY OF THE HYDRODYNAMIC STABILITY OF INHOMOGENEOUS PLASMA FLUXES
E. E. Lovetsky and A. A. Rukhadze *In its* Nucl. Fusion, vol. 6, no. 1, 1966 Sep. 1966 p 14–25 refs (See N67-17303 07-25) CFSTI: HC $3.00/MF $0.65

The stability of a multicomponent flow of cold inhomogeneous plasma with respect to conservative electromagnetic oscillations is investigated in two-fluid hydrodynamics. It is shown that when there is a strong external axial magnetic field parallel to the plasma flux, the inhomogeneous plasma may be unstable with respect to short-wave oscillations described by the methods of geometrical optics. The instabilities considered can develop when there is no beam instability in the plasma, and long-wave instability is possible even in a currentless plasma. The long-wave instability is by its nature analogous to the Rayleigh flow instability of an ideal fluid with an inhomogeneous velocity profile. Author

N67-17306# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
INSTABILITY OF A HOT CATHODE DISCHARGE IN A MAGNETIC FIELD AT LOW PRESSURES
M. A. Vlasov, E. I. Dobrokhotov, and A. V. Zharinov *In its* Nucl. Fusion, vol. 6, no. 1, 1966 Sep. 1966 p 26–53 refs (See N67-17303 07-25) CFSTI: HC $3.00/MF $0.65

Results of the investigation of an incandescent-cathode discharge in an equipotential volume in a magnetic field of 2000 O_e. In the pressure range studied, 2×10^{-6} to 10^{-4} Torr, there is formed a plasma column negatively charged in relation to the surrounding walls. It is established that, when the pressure of the neutral gas is increased, such a discharge becomes unstable. A plasma torch is formed which rotates steadily in the direction of the electrons and escapes from the region of the primary beam. The fundamental principles underlying this discharge behavior are explained. By means of a simplified model an expression for the rotation frequency of the torch is obtained and confirmed qualitatively by experiment. Author

N67-17307# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
PROBING A PLASMA BY ELECTROMAGNETIC WAVES
Yu. N. Dnestrovsky and D. P. Kostomarov *In its* Nucl. Fusion, vol. 6, no. 1, 1966 Sep. 1966 p 54–65 refs (See N67-17303 07-25) CFSTI: HC $3.00/MF $0.65

The problem of determining the spatial density distribution of a magnetized plasma containing cold electrons is examined by using the measured phase difference between the incident and reflected waves in a given frequency range. With the methods of geometrical optics the problem yields Volterra's integral equations of the first kind. If the external magnetic field is homogeneous the equations are linear; otherwise they are nonlinear. The equations are studied by numerical methods. The absorption of electromagnetic waves in relation to the problem of probing a plasma is also considered. Author

N67-17308# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
INTERACTION OF FAST PLASMOIDS WITH MAGNETIC FIELD BARRIERS
S. Chwaszczewski *In its* Nucl. Fusion, Vol. 6, No. 1, 1966 Sep. 1966 p 67–85 refs (See N67-17303 07-25) CFSTI: HC $3.00/MF $0.65

The interaction of fast plasmoids with barriers that are constant or variable in time is considered. During the investigation with a steady state magnetic field, compression of the plasma was observed at low field intensities. At high intensities the density of the plasmoids penetrating the barrier decreased until the plasma was completely reflected by the barrier. The variable magnetic field interactions were determined not only by the field intensity amplitude, but also by a whole set of interaction phases. Values characterizing these phases are introduced, and the reflection, partial penetration, and acceleration of the plasmoids were measured for different interaction parameters. A.G.O.

N67-17309# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
POLARIZED PYROMETRIC PROBE: PRINCIPLES OF OPERATION AND MEASUREMENT OF PLASMA PARTICLE ENERGY
R. Bardet and R. Geller *In its* Nucl. Fusion, vol. 6, no. 1, 1966 Sep. 1966 p 86–93 refs (See N67-17303 07-25) CFSTI: HC $3.00/MF $0.65

The polarized pyrometric probe is a thermally insulated electrostatic probe made of tungsten or carbon. Unlike the Langmuir probe, its operating characteristic is located beyond the knees on the curve indicating ion and electron saturation. In hot, dense plasmas the radiance of this probe, inferred from the temperature reading on the pyrometer, is compared with the VI product (voltage times current) of the characteristic. It is then easy to calculate the energy of the particles and to estimate their density. The principle underlying these measurements is explained and illustrated by two experimental applications for ions of 300 and 1200 eV. Author

N67-17350# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Groupe de Recherches sur la Fusion Controlée.
WAVES IN INHOMOGENEOUS PLASMA OF CYLINDRICAL GEOMETRY [ONDES DANS LES PLASMAS INHOMOGENES EN GEOMETRIE CYLINDRIQUE]
P.-H. Rebut Brussels, EURATOM, Nov. 1966 73 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-007-62-1 FUAF)
(EUR-2725.F; CEA-R-2960) CFSTI: HC $3.00/MF $0.65

The conductivity tensor of a hot and inhomogeneous plasma has been calculated for a cylindrical geometry using Vlasov's equations. The method used consists in a perturbation method involving the first integrals of the unperturbed movement. The conductivity tensor will be particularly useful for dealing with stability problems. In the case of a cold plasma the wave equation giving the electric fields as a function of the radius is obtained. This equation shows the existence of resonant layers which lead to an absorption analogous to the Landau absorption in a hot plasma. Author

N67-17385# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
NUCLEAR FUSION Selected Articles
1966 85 p refs Transl. into ENGLISH from Nucl. Fusion (Vienna), v. 5, no. 1, 1965 p 7–16; 20–40; 85–86
(AEC-TR-6669) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. PHYSICAL MECHANISM OF ION ENTRAINMENT BY THE ELECTRON SPACE CHARGE IN ACCELERATION BY THE GRADIENTS OF STATIC MAGNETIC AND OF ELECTROMAGNETIC FIELDS R. Bardet, T. Consoli, and R. Geller p 1–23 refs (See N67-17386 07-25)

2. MULTIPARTICLE ASPECTS OF TURBULENT-PLASMA THEORY A. A. Galeev, V. I. Karpman, and R. Z. Sagdeev p 24–74 refs (See N67-17387 07-25)

3. IONIZATION OF ENERGETIC HYDROGEN ATOMS IN A STRONG MAGNETIC FIELD E. S. Borovik, F. I. Busol, V. A. Kovalenko, E. I. Skibenko, and V. B. Yuferov p 75–79 refs (See N67-17388 07-25)

N67-17386# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
PHYSICAL MECHANISM OF ION ENTRAINMENT BY THE ELECTRON SPACE CHARGE IN ACCELERATION BY THE GRADIENTS OF STATIC MAGNETIC AND OF ELECTROMAGNETIC FIELDS
Rene Bardet, Terenzio Consoli, and Richard Geller *In its* Nucl. Fusion 1966 p 1–23 refs (See N67-17385 07-25) CFSTI: HC$3.00/MF$0.65

A theory of the physical mechanism of ion entrainment by accelerated electrons is presented. It is shown that under the influence of these fields the electrons describe helixes whose diameter and pitch vary along the axis of motion as a function of the difference between the cyclotron frequency and the frequency of the applied hf field. The space charge thus created accelerates the ions. The coupling between the equations of motion of the electron and ion fluids calls for the introduction of a tensor mass; viz., that of the relativistic mass of the electrons in the two equations in x and y describing the transverse movement of the electrons, and that of the ions in the axial motion equation in z. The physical consequences of this theoretical study are then discussed, and three typical experimental results are given that illustrate three of these consequences. Author

N67-17387# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
MULTIPARTICLE ASPECTS OF TURBULENT-PLASMA THEORY
A. A. Galeev, V. I. Karpman, and R. Z. Sagdeev *In its* Nucl. Fusion 1966 p 24–74 refs (See N67-17385 07-25) CFSTI: HC$3.00/MF$0.65

A review is given of theoretical work performed in connection with a new approach to the theory of a weakly turbulent plasma. The essence of this approach is the representation of turbulent plasma as an aggregate of weakly interacting gases of particles (ions, electrons) and quasi-particles (collective oscillations). In such a scheme are included also instability effects (playing the role of sources in the kinetic equations for quasi-particles). As applications of this method, which is thus a generalization of the known quasi-linear theory, some anomalous transfer phenomena that appear as the result of different types of plasma instability have been discussed. Author

N67-17388# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
IONIZATION OF ENERGETIC HYDROGEN ATOMS IN A STRONG MAGNETIC FIELD
E. S. Borovik, F. I. Busol, V. A. Kovalenko, E. I. Skibenko, and V. B. Yuferov *In its* Nucl. Fusion 1966 p 75–79 refs (See N67-17385 07-25) CFSTI: HC$3.00/MF$0.65

To determine the fraction of 30 keV hydrogen atoms that were ionized by the Lorentz force in a magnetic field up to 60 kG, we performed a direct measurement. The ions were measured with three collectors (before, in and after the central magnetic field of 2.2 cm radius); at fields above 25 kG all the ions appeared at the central collector that had a sensitivity 0.5 nA. At fields of 55 to 60 kG, the fraction (5 to 4) $\times 10^{-4}$ of the hydrogen atoms were ionized by Lorentz ionization, that is an ion current about 0.05 μA and an equivalent neutral current about 100 μA. From 32 to 51 kG, ionization is from the state n=9, for larger fields from n=8. Author

N67-17411# Nagoya Univ. (Japan). Inst. of Plasma Physics.
REPORT OF THE 1965 NAGOYA MEETING ON SPACE PLASMA PHYSICS
Dec. 1965 109 p refs In JAPANESE
(IPPJ-44(J))

Information is presented on solar plasma and its interaction with the magnetic field of the earth. The following earth-related phenomena and their relation to the solar wind are discussed: hydromagnetic instabilities, magnetospheric boundary, radiation belts, ionospheric layers, and related atmospheric disturbances. The evolution and dynamics of radio galaxies are considered in the framework of relativistic cosmology. NSA

N67-17440# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
THE LIFETIME OF INDIVIDUAL CHARGED PARTICLES IN MIRRORED MAGNETIC TRAP [VREMYA ZHIZNI OTDEL'NYKH ZARYAZHENNYKH CHASTITS V MAGNITNOI LOVUSHKE]
V. M. Balebanov and N. N. Semashko 1966 60 p refs In RUSSIAN
(IAE-1078)

The lifetime of individual charged particles in stationary magnetic-mirror traps was measured as function of the various pertinent parameters. Comprehensive theoretical derivations support numerous experimental data presented in the form of graphs and tables. Results confirm the theoretical predictions of the exponentially small character of the changes in magnetic moments relative to the adiabatic parameter during particle motion near the reflection point. For a given Orgy-I magnetic field configuration, the exponent and coefficients of the exponential term of the expression for the change of magnetic moment assuming random and resonant accumulation processes were found. Lifetimes measured in the presence of axially symmetric perturbations of the magnetic field are in satisfactory agreement with the newly derived theoretical expression. For conditions corresponding to absolute retention of particles within a limited space (in "Stoermer zones") there appeared an anomalous increase in electron lifetimes within the trap. NSA

N67-17441# United Kingdom Atomic Energy Authority, Culham (England).
THE VACUUM SYSTEM OF OGRA-II
S. S. Butuzov, Yu. M. Pustovoit, and E. A. Maslennikov [1966] 23 p refs Transl. into ENGLISH from IAE Rept. IAE-1113
(NP-TR-1398; CTO-299) CFSTI: HC$3.00/MF$0.65

The vacuum system in Ogra-II is described. It consists of an ion gun, a neutralization chamber, a differential pumping system and the working chamber in which the plasma is trapped. Calculations and experimental results are given for the differential pumping system, showing a pressure drop from 10^{-5} torr at

the entry into working chamber over a length of 3 meters, with a beam path aperture of area ≈200 cm^2. The conditions are discussed under which heating and cooling of the device takes place, and pressures of $\approx 10^{-10}$ torr are obtained in the trap without beam. The composition of the residual gases during the various stages of evacuation is given. Reasons are considered for the rise of pressure to 10^{-9} torr during the accumulation of the plasma, and methods for the pulsed pressure measurements in the working chamber in the presence of the accumulating plasmas are described. Author (NSA)

N67-17449# Oak Ridge National Lab., Tenn. Thermonuclear Div.

PRESENT STATUS AND OBJECTIVES OF THE DCX-2 EXPERIMENT

P. R. Bell, G. G. Kelley, N. H. Lazar, and J. F. Lyon Sep. 1966 11 p refs

(Contract W-7405-ENG-26)

(ORNL-4011) CFSTI: HC $3.00/MF $0.65

It is concluded that the DCX-2 program will lead to an understanding of the factors which determine hot plasma density in the device itself and that there is promise of the attainment of densities in the range of thermonuclear interest. Whether or not this goal is reached, the program is continuing to play an important part in the elucidation of problems leading to controlled thermonuclear power. It is serving as a test for instability theories and is stimulating further theoretical work. It has provided densities in excess of theoretically predicted instability thresholds and in fact has produced the highest densities and plasma pressures yet attained in a high-energy injection device. Future experiments should give definite answers to the question of scaling. The course of action and indeed the feasibility of high-energy injection for thermonuclear power should then be clear. Author (NSA)

N67-17487# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.

DRIFT INSTABILITY OF PLASMA DISCHARGE WITH OSCILLATING ELECTRONS [DREIFOVAYA NEUTOICHIVOST' PLAZMY RAZRYADA S OSTSILLIRUYUSHCHIMI ELEKTRONAMI]

L. A. Dushin, Yu. K. Kuznetsov, and O. S. Pavlichenko 1966 11 p refs In RUSSIAN; ENGLISH summary

(NP-16310)

The existence was established earlier of an anomalous increase in charged particle flow in a direction perpendicular to the magnetic field in discharges with oscillating electrons. The connection between the above drift instability (appearing for above-critical values of the magnetic field and leading to a loss of charged particles from the plasma) and the strong simultaneous low frequency oscillations of the plasmas is reported. The description of the experimental device and the presentation of the recorded data is followed by a comprehensive theoretical discussion which shows that the observed oscillations are caused by the drift-dissipative instability of inhomogeneous plasmas. NSA

N67-17532# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).

PLASMA DENSITY SPATIAL DISTRIBUTION MEASUREMENTS BY MEANS OF MULTI BEAM MICROWAVE PROBING [OPREDELENIE PROSTRANSTVENNOGO RASPREDELENIYA PLOTNOSTI PLAZMY MNOGOLUCHEVYM MIKROVOLNOVYM ZONDIROVANIEM]

E. P. Gorbunov, Yu. N. Dnestrovskii, D. P. Kostomarov, and B. F. Mul'chenki [1965] 16 p refs In RUSSIAN

(IAE-1153)

The electron density distribution in the transverse cross section of a plasma cylinder can be determined by measuring the phase shift of millimeter waves sent through different parts of the plasma in two mutually perpendicular directions. Axial symmetry is assumed. However, during the time of discharge the plasma loop changes its position with respect to the center of the chamber so that it is possible to disturb the axial symmetry in the distribution of plasma along the cross-section of the loop. Hence a method of determining the electron density distribution is developed for the case where axial symmetry is lacking. It is assumed that the form of the lines along which the plasma density remains constant is known, and that only the density along the lines need be determined. A method of solving this problem is presented, and a concrete example is worked out with the use of actual experimental data. It is necessary to solve a first-order integral equation by numerical methods. Analysis shows that axial symmetry is maintained at the initial and middle portions of the discharge, but that symmetry is disturbed at the end of the discharge with a shift in the horizontal direction. NSA

N67-17534# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).

THE INFLUENCE OF TRANSVERSE CURRENTS ON THE EQUILIBRIUM OF TOROIDAL PLASMA IN THE PRESENCE OF CONDUCTING WALLS [VLTYANIE POPERECHNYKH TOKOV NA RAVNOVECIE TOROIDALNOI PLAZMY PRI NALICHII PROVADYASHCHEGO KOZHUKHA]

V. S. Mukhatov [1965] 16 p refs In RUSSIAN

(IAE-1152)

In the Tokomak units the plasma loop is formed by means of a metallic diaphragm, and theoretically, the equilibrium position of the plasma loop in the conducting sheath should be shifted outwards. A plasma of noticeable density should be observed at the edges of the diaphragm and at certain parts of its shadow. Transverse currents due to toroidal charge drift can be grounded through the diaphragm in this way. On the Tokamak-5 unit it is found experimentally that with an ordinary (annular) diaphragm the effect of current short-circuiting via the diaphragm on the equilibrium of the plasma loop is negligibly small under typical discharge conditions. At the same time it is possible to modify the discharge conditions in such a fashion that the effect of these currents on the plasma equilibrium becomes noticeable. A difference in potential between two molybdenum strips (simulating a diaphragm) is created by an external feed source so as to obtain a transverse current in the plasma. The effect of this current on the equilibrium of the plasma loop agrees well with that predicted by theory. NSA

N67-17539# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.

EXPERIMENTAL INVESTIGATION OF CUSPED CONTAINMENT GEOMETRIES Annual Report, 1965–1966

George J. Yevick 1966 205 p refs

(Contract AT(30-1)-2582)

(SIT-2582-19; SIT-187) CFSTI: HC $3.00/MF $0.65

Experimental results from the performance of the Chalice system are discussed and their analyses, which include data with preheater and cusp bank and preheater alone, are given. Information is also included on the following: diagnostics, including optical, improvements in the bank system, the suppression of r-f noise, magnetic fields, vacuum systems and θ-pinch guns, the snow-plow model for fast pinches, and collective coordinates for inhomogeneous plasmas. Results indicate fairly accurate repeatability in the performance of the Chalice system. NSA

N67-17583# Princeton Univ., N. J. Plasma Physics Lab.
THERMAL INSULATION OF PLASMA IN TOKAMAK
L. A. Artsimovich, G. A. Bobrovskii, C. B. Mirnov, K. A. Razumova, and B. C. Strelkov Aug. 1966 22 p refs Transl. into ENGLISH from Russian Presented at Intern. Symp. on Exptl. and Theoret. Aspects of Toroidal Confinement, Princeton, N. J., 11–15 Jul. 1966
(Contract AT(30-1)-1238)
(MATT-TRANS-35; CONF-660717-1) CFSTI: HC $3.00/MF $0.65

As a measure of the effectiveness of the thermoinsulation in installations designed for production and retention of high temperature plasmas, the quantity τ_ϵ defined from the condition $\tau_\epsilon = W(Q - dw/dt)^{-1}$ is used. W is the total energy of plasma configuration, Q is the quantity of heat arriving at the plasma from heat sources per unit of time, and the quantity τ_ϵ is called the time of retention of energy in the plasma. The methods and results of measurement of τ_ϵ for the Tokamak installation are analyzed. NSA

N67-17584# Princeton Univ., N. J. Plasma Physics Lab.
TOPOLOGY OF MAGNETIC FIELD AND DIFFUSION OF PLASMA IN TOROIDAL TRAPS
A. Popryadukhin Sep. 1966 29 p refs Transl. into ENGLISH from Russian Presented at Intern. Symp. on Exptl. and Theoret. Aspects of Toroidal Confinement, Princeton, N. J., 11–15 Jul. 1966
(Contract AT(30-1)-1238)
(MATT-TRANS-37; CONF-660717-3) CFSTI: HC $3.00/MF $0.65

The effects of disturbances of the magnetic field of an "ideal" toroidal trap on plasma diffusion is considered. It is shown that an equilibrium electric field may lead to collisional diffusion of a quiet plasma, even for a zero Larmor particle radius. Author (NSA)

N67-17585# Princeton Univ., N. J. Plasma Physics Lab.
EXPERIMENTS WITH STELLARATOR L-1
D. K. Akulina, M.S. Berezhetskii, G. M. Batanov, A. P. Popryadukhin, M. S. Rabinovich et al Aug. 1966 35 p refs Transl. into ENGLISH from Russian Presented at Intern. Symp. on Exptl. and Theoret. Aspects of Toroidal Confinement, Princeton, N. J., 11–15 Jul. 1966
(Contract AT(30-1)-1238)
(MATT-TRANS-36; CONF-660717-2) CFSTI: HC $3.00/MF $0.65

External injection of plasma streams into a closed magnetic container was performed and investigated. The retention of a currentless plasma with helical stellarator fields was studied. NSA

N67-17804 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
EXTRATERRESTRIAL ELECTRON DENSITY MEASUREMENTS. PART I: CHOICE OF METHOD OF MEASUREMENT
H. H. Rabben Dec. 1965 27 p refs In GERMAN
(MPI-PAE-Extraterr.-19/65)

Application of known methods of measurement (wave propagation and plasma probes) is discussed and a new method for measurements in the magnetosphere and interplanetary medium is proposed which is based on the interaction of plasma and electromagnetic waves. ESRO

N67-17805# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
PRODUCTION OF RECOMBINATION CONTINUA IN A SPARK DISCHARGE FOR ABSOLUTE INTENSITY MEASUREMENT IN THE VACUUM ULTRAVIOLET [ERZEUGUNG VON SERIENGRENZKONTINUA MIT HILFE VON GLEITFUNKEN ZUR ABSOLUTMESSUNG IM VACUUM-ULTRAVIOLETT]
H. Conrads Mar. 1966 47 p refs In GERMAN
(JUL-360-PP) CFSTI: HC $3.00/MF $0.65

During production by spark discharge of an intensive emission spectrum of ionization energies up to 390 eV, the Bremsstrahlung of Li III is emitted in the visible and infrared spectra from a lithium plasma, and the recombination continua of Li III in the vacuum ultraviolet. The temperature of the electrons was determined from the absolute intensity in the infrared, and the density from the visible and the Stark broadening of Li III Lyman lines. During observation the temperature falls and the density increases. For these temperatures and densities of the lithium plasma the free electrons have a Maxwellian distribution. The temperature at the longitudinal spark axis is constant and therefore the plasma layer has a defined length so that the absolute intensities of the recombination continua are determined. They are measured simultaneously in the infrared, visible and vacuum ultraviolet and are given between 60 A and 100 A. ESRO

N67-17816 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
ON THE PROPAGATION OF COMPRESSION WAVES IN AN ISOTHERMAL ATMOSPHERE WITH VERTICAL MAGNETIC FIELD [UEBER DIE AUSBREITUNG VON KOMPRESSIONSWELLEN IN EINER ISOTHERMEN ATMOSPHAERE MIT VERTIKALEM MAGNETFELD]
Manfred Scholer Jul. 1965 67 p refs In GERMAN
(MPI-PAE-Extraterr.-9/65)

In the first part of this report the influence of lateral energy transfer on the propagation of a hydrodynamic wave of finite amplitude is examined and compared with one-dimensional calculations. In the second part a vertical magnetic field is included in the calculations. The wave propagation in a supposedly infinite electrically conductive atmosphere is dealt with in the scope of magnetohydrodynamic approximation. As well as in the case without magnetic field the partial nonlinear differential equation system was numerically integrated. It is shown that the magnetic field is sharply bounding the wave horizontally and is leading it along the field lines. This focusing of the shock wave originated in high altitudes may be of importance for the description of the spicules. ESRO

N67-17847 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
MODEL CALCULATION FOR DETERMINATION OF GEOMETRIC SHAPE OF BOUNDARY SURFACE OF MAGNETOSPHERE [MODELLRECHNUNG ZUR GEOMETRISCHEN GESTALT DER GRENZFLAECHE DER MAGNETOSPHAERE]
W. Pilipp Jul. 1965 72 p refs In GERMAN
(MPI-PAE/16-65) CFSTI: $3.00

In order to determine the geometrical shape of the outer boundary of the magnetosphere, models with simplified physical assumptions have been considered by several authors. Some typical examples are discussed in this report and the influence of thermal agitation of plasma particles on the shape of the nightside of the magnetosphere is examined. Corresponding methods for computation are described and results of the numerical calculations given. These are compared with measurements made by the satellite IMP-1. Author (ESRO)

N67-17871*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
PLASMAS AND SPACE PHYSICS Progress Report, 1 Aug. 1965–31 Jan. 1966
Derek A. Tidman 20 Jan. 1966 5 p refs
(Grant NsG-220-62)
(NASA-CR-69939) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Physical progress is reported for the following research studies: (1) *Enhanced Fluctuations in Plasmas*—turbulent motion effects on scattering and emission of electromagnetic radiation by plasma; (2) *The Role of Electrostatic Plasma Oscillations in Electron Scattering in the Earth's Outer Magnetosphere*—electron scattering in spatially homogeneous magnetic field-free plasma by ion and electron plasma waves excited by suprathermal particles; (3) *Enhanced Bremsstrahlung from Plasmas Containing Nonthermal Electrons*—calculation of bremsstrahlung emitted from thermal plasmas co-existing with energetic flux electrons; (4) *Scattering of a Test Particle by Enhanced Plasma Fluctuations*—wave-particle plasma scattering; (5) *Propagation of Correlation in a Boltzmann Gas*—free path and collision time scale; (6) *An Asymptotic Kinetic Equation for Inhomogeneous Plasma*—new kinetic equation; (7) *Plasma Radiation and Solar Radio Outbursts*—plasma harmonics splitting; and (8) *Correlation Velocities*—space-time behavior of velocities. G.G.

N67-17925 Royal Aircraft Establishment, Farnborough (England).
ON THE INFLUENCE OF OXIDE LAYERS ON ARC MOVEMENT IN A MAGNETIC FIELD [UEBER DEN EINFLUSS VON OXIDSCHICHTEN AUF DIE LIGHTBOGENBEWEGUNG IM MAGNETFELD]
G. Burkhard Oct. 1966 18 p refs Transl. into ENGLISH from Elektrie (Berlin), no. 6, 1966 p 229–232
(RAE-LIB-TRANS-1181) CFSTI: $3.00

Only a little, and contradictory information is available on the influence of the oxidation of metal electrodes on the velocity of a moving arc. Some investigations have been carried out with currents up to 100 A in which arcs rotate on copper electrodes with various degrees of heavy oxidation. The arc movement has been studied with special interest. It was found that the initial arc velocity with very thin oxide layers is higher than with thicker oxide layers, and also exceeds the arc velocity on non-oxidised polished electrodes. The maximum velocity was observed with electrodes which had the track left by an arc in previous experiments. Author

N67-18008*# National Bureau of Standards, Washington, D. C.
TURBULENCE BY ELECTROSTATIC FLUCTUATIONS
C. M. Tchen 1 Nov. 1966 22 p refs
(NASA Order R-127)
(NASA-CR-81719; NBS-9435) CFSTI: HC $3.00/MF $0.65
CSCL 20I

The spectra of turbulence and density fluctuations in a plasma are derived from a hydrodynamic description. The turbulent spectrum is governed by a turbulent cascade process, a viscous dissipation, and a diffusion by electrostatic fluctuations. The density spectrum is governed by a density cascade process and a dissipation by collisions. The strong and weak interactions between waves are considered in the 2 cascade processes. The integral equations for the spectral functions are solved for the following three subranges: inertial convection subrange, viscous diffusive subrange, and inertial-diffusive subrange. Author

N67-18101# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
EXCITATION OF SURFACE CURRENTS ON A PLASMA-IMMERSED CYLINDER BY ELECTROMAGNETIC AND ELECTROKINETIC WAVES
Edmund K. Miller Sep. 1966 110 p refs
(Contract NASR-54(05); Grant NsG-472; ORA Proj. 05627)
(NASA-CR-81737; Rept.-05627-4-S) CFSTI: HC $3.00/MF $0.65
CSCL 20I

Surface currents excited by plane electromagnetic (EM) and electrokinetic (EK) waves on a metal cylinder immersed in a uniform, collisionless isotropic plasma are treated linearly. The sheath which forms about the cylinder, assumed to be at floating potential, is represented by two models. In the vacuum model, the sheath is approximated by a free-space layer. For an arbitrary angle of wave incidence, the vacuum sheath tends to screen the EK wave from the cylinder and produces a large attenuation of the surface currents. The sheath and EK wave negligibly affect the currents excited by the EM wave. The inhomogeneous sheath model includes the actual sheath in the formulation. Surface currents for EK wave incidence substantially agree with results obtained from the vacuum sheath model. the inhomogeneous sheath model has the effect of decreasing the currents excited by the EK wave. For EM wave incidence, the surface currents are negligibly affected by both the inhomogeneous sheath and plasma compressibility. Author

N67-18119# Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF THE SHAPE OF AN ELECTRIC ARC DISCHARGE ROTATING IN AN ANNULAR GAP UNDER THE INFLUENCE OF A NON-UNIFORM LONGITUDINAL APPLIED MAGNETIC FIELD
J. M. Shaw London, HMSO, 1966 25 p refs Supersedes RAE-TN-AERO-2965; ARC-26358; see X64-17985
(ARC-CP-858; RAE-TN-AERO-2965; ARC-26358; AD-803302) CFSTI: HC $3.00/MF $0.65

This paper explores the possible shapes of an electric arc discharge rotating in an annular gap under the influence of a non-uniform longitudinal magnetic field. It is shown that there are two families of possible arc shapes, all dependent on the form of the applied magnetic field. The first extend outwards from a radius r where the arc is radial and the second extend inwards from radius r. The first family can be subdivided into three types. Arcs which are S-shaped, extending only to a second radius where they are again radial; arcs which may extend out to infinity in an involute-like form; and arcs which are involute-like near to r but terminate as a circle at a radius where the magnetic field is zero. The second family can be subdivided into two types. Arcs which are S-shaped, extending only to a smaller radius where they are again radial; and arcs which terminate as a circle at a radius where the magnetic field is zero. The circle may have zero radius in the limiting case where the field is zero at the centre. It is shown that under certain precise conditions arcs may extend from one family through radius r to the other family forming one long uniformly rotating arc. Finally, the possible marriage of an arc from the first family with one from the second family to form a mutually compatible arc pair is demonstrated. In this case the arcs rotate in opposite directions. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-16731# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE NATURE OF SMALL DEFECT CLUSTERS, VOL. 1
M. J. Makin, ed. Sep. 1966 338 p refs Rept. of a Consultants Symp., held in Harwell, Engl., 4–6 Jul. 1966
(AERE-R-5269, Vol. 1) HMSO: 48s

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16. THE SCATTERING OF LONG WAVELENGTH NEUTRONS BY DEFECT CLUSTERS IN QUARTZ I. H. Wilson and D. C. Clark Reading Univ.) p 253–267 refs (See N67-16747 07-26)

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N67-16732# United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.

REMARKS ON THE FORMATION OF DEFECT CLUSTERS BY IRRADIATION

R. von Jan *In its* Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 1–7 refs (See N67-16731 07-26) HMSO: 48s

The formation of defect clusters by irradiation is predominantly controlled by the spatial distribution of the defects in displacement cascades. This type of defect production may lead to an accumulation of the vacancies and separation from the interstitials due to three mechanisms: (1) focused replacement sequences, (2) cascade effects, and (3) spontaneous recombination. It is shown that the combined effects of these mechanisms should result in strong separation of the two defect types in noble metals. The effect increases with increasing hardness of the interatomic potential.

Author

N67-16733# Argonne National Lab., Ill.

RADIATION-INDUCED POINT DEFECT CLUSTERS IN COPPER AND GOLD

K. L. Merkle *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 8–37 refs (See N67-16731 07-26) HMSO: 48s

The transmission electron microscope technique was used to investigate the defect structures introduced by bombardment of thin films of copper and gold with heavy particles. The effects of energetic primary knock-ons are investigated, and observations in connection with the formation of clusters are given. Black spot defects in gold are shown to be produced directly in displacement cascades if the energies of the cascades are high enough. The size of the observed defect clusters increases with increasing primary energy. Charged particle irradiations of copper indicate that not every primary event above a certain threshold energy is observed. This is interpreted as being due to the formation of non-overlapping subcascades, each of which might form a stable cluster but is generally too small to be observed.

A.G.O.

N67-16734# United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.

POINT DEFECT INTERACTIONS IN HARMONIC CUBIC LATTICES

J. R. Hardy and R. Bullough *In its* Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 38–52 refs (See N67-16731 07-26) HMSO: 48s

If one applies continuum elasticity to the problem of the interaction between two similar point defects in a crystal then one finds that, to lowest order, the interaction energy: $E = -G^{ijkl} \mathrm{div}\, \Xi^{ij}(R)$, where R is the interdefect spacing, $\Xi^{ij}(R)$ is the displacement field of the first defect evaluated at the position of the second, and each defect is simulated by a distribution of body force $-G^{ijkl}$ grad $\delta(r)$. For an isotropic crystal div $\Xi^{ij}(R)$vanishes and there is thus no interaction to this order. For this reason it is usually asserted that the lowest order interaction between two point defects is the induced interaction which is quadratic in the strains produced by one defect at the other and thus varies $|R|^{-6}$. A method of calculating the interaction I(R) on the basis of lattice theory is presented. This method takes into account the discrete nature of the crystal throughout and can thus be applied when the interdefect spacing is comparable with the lattice parameter.

Author

N67-16735# United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.

THE NUCLEATION OF INTERSTITIAL LOOPS IN IRON

R. Perrin and R. Bullough *In its* Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 52–67 refs (See N67-16731 07-26) HMSO: 48s

Two types of interstitial loop lying on the {111} or {100} plane have been observed in irradiated b.c.c. metals. It has been suggested that such loops may have a common nucleation morphology. The purpose of the present work is to investigate the validity of this suggestion for b.c.c. iron using a discrete atom

model with the central pairwise interatomic potential recently proposed by Johnson. The procedure was to first introduce a single interstitial and allow the neighboring atoms to relax; this led to the expected split in various positions configuration (along a <110> axis). A second interstitial was then inserted in various position relative to the first and the stable diinterstitial configuration was determined; this occurred with the interstitials in neighboring positions and both split in the same <110> direction. Successive interstitials were then introduced and the minimum energy configuration determined. The results do in fact support the suggestion that the {110} plane is a suitable common nucleation plane for the interstitial platelet. Author

N67-16736# Brookhaven National Lab., Upton, N. Y.
SOME KINETIC CONSIDERATIONS OF DEFECT CLUSTERING
A. C. Damask *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 68–83 refs (See N67-16731 07-26) HMSO: 48s

Kinetic approaches to the description of point defect clustering phenomena are reviewed. High divacancy mobility is shown to complicate both analytic and computer solutions except in the special cases in which the number of vacancy sinks is pre-established by some special characteristic of the metal under investigation. Interstitial clustering is complicated by the presence of vacancies. An approximate solution has been found for interstitial clustering kinetics in the presence of impurities or other nucleating faults under the assumption that equilibrium among the clusters prevails and that the vacancies resulting from neutron damage are primarily in clusters rather than randomly distributed. Author

N67-16737# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
NUCLEATION OF VACANCY CLUSTERS IN QUENCHED ALUMINUM AND GOLD
M. Meshii, J. A. McComb, K. Y. Chen, and T. H. Mori (Mitsubishi Electric Mfg. Co.) *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 84–105 refs Prepared in Cooperation with Mitsubishi Electric Mfg. Co. (See N67-16731 07-26) HMSO: 48s

The nucleation process has been analyzed in both gold and aluminum to provide information applicable to the formulation of a theory of vacancy cluster nucleation. Critical temperatures and thermal stability of vacancy clusters are examined, and the morphology of aluminum quenched into liquid nitrogen is discussed. Consideration is also given to aging temperature effects on cluster formation, formation of colonies in nucleation reactions, reactions during quenching, heterogeneous and homogeneous nucleation, approximated nucleation kinetics, and the stability of nuclei and formation energies of vacancy clusters. A.G.O.

N67-16738# Oslo Univ., Blindern (Norway).
THE NUCLEATION OF DISLOCATION LOOPS IN ALUMINUM
T. L. Davis and J. P. Hirth (Ohio State Univ.) *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 106–113 refs Prepared in Cooperation with Ohio State Univ. (See N67-16731 07-26) HMSO: 48s

Quenching experiments with aluminum have been conducted to clarify the role impurities play in the nucleation process. Loop densities observed in specimens for several different quenching conditions are shown, and the interaction between the impurities and the nucleating dislocation loops is examined. Results indicate that the role of impurities is a complex one, with particular impurity atoms probably increasing the rate of dislocation loop nucleation. The effectiveness of the impurity as a nucleating site is decreased when the supersaturation of vacancies decreases and when the impurity is clustered with other impurity atoms. A.G.O.

N67-16739# Cambridge Univ. (England). Dept. of Metallurgy
IMPURITY NUCLEATION OF RADIATION DAMAGE IN GRAPHITE
A. Kelly and R. M. Mayer *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 114–124 refs (See N67-16731 07-26) HMSO: 48s

It has been suggested that boron impurity in graphite crystals can act as an efficient nucleating agent for defect clusters. Direct evidence for this has been obtained and experiments conducted to investigate why boron should act in this way. Purified graphite single crystals have been doped with boron 10 and boron 11 isotopes. After irradiation to 7×10^{19} neutrons/cm^2 at 650°C, the distribution of interstitial clusters (typically about 60Å radius) has been examined using the electron microscope. The number of clusters increases and the cluster size decreases with increasing boron content. The lack of difference between boron 10 and boron 11 dopings, shows that the B^{10} (n,α) Li^7 reaction is not primarily responsible for this behavior. Author

N67-16740# Virginia Univ., Charlottesville. Dept. of Physics.
THE STABILITY OF SMALL VACANCY CLUSTERS AS A FUNCTION OF THEIR SIZE AND SHAPE
Julius A. Sigler and Doris Kuhlmann-Wilsdorf *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 125–143 refs (See N67-16731 07-26) HMSO: 48s

On the basis of the most accurately known expressions relating to the energies of Frank dislocation loops, perfect prismatic dislocation loops, stacking fault tetrahedra, and voids, machine calculations have been performed to determine the relative stabilities of the named crystal defects in the most common fcc metals, namely aluminum, gold, copper, silver, nickel and platinum. The results indicate only partial agreement between the theoretically most stable form of vacancy aggregate and relevant experimental observations. It is possible that these disagreements are due to imperfectly known parameters such as stacking fault energy, dislocation core energy and surface energy. The alternative possibilities that the discrepancies discovered are either the result of interactions between vacancies and impurity atoms, or of difficulties in transforming any of the named crystal defects into any of the other forms, are also considered. Author

N67-16741# Argonne National Lab., Ill.
A BRIEF REVIEW OF ENERGY CALCULATIONS FOR CLUSTERS OF POINT DEFECTS IN METALS
R. M. J. Cotterill *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 144–172 refs (See N67-16731 07-26) HMSO: 48s

The various phenomena associated with the production of non-equilibrium concentrations of point defects in metals are examined. Types of point defect clusters which have been observed in f.c.c. metals are reviewed, and the approaches that have been used to calculate their energies are discussed. Emphasis is given to vacancy-type defects, since more experimental data have been obtained for this type of defect. However, most of the discussion can be applied easily to interstitial clusters. The significance of the results of the various calculations is also considered. A.G.O.

N67-16742# General Electric Co., Cincinnati, Ohio.
VACANCY AND INTERSTITIAL CLUSTERS IN α-IRON

J. R. Beeler, Jr. *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 173–210 refs (See N67-16731 07-26) HMSO: 48s

Kinetic and static aspects of vacancy cluster nucleation, growth, and removal are investigated in pure α-iron. Considerations pertinent to vacancy cluster nucleation properties are treated in a description of the binding energy as a function of cluster size for each of three classes of cluster structure. The attachment energy of a vacancy to different types of cluster surface facets is studied, and the most likely migration path of a vacancy which encounters a cluster is delineated. Results of calculations on the activation energy for cluster dissociation and an attempt to simulate the collapse of planar clusters are also discussed. The computation of interstitial cluster properties was limited to defining the most stable structure and the associated binding energy. A.G.O.

N67-16743# Argonne National Lab., Ill.

A STUDY OF SMALL VACANCY CLUSTERS ON (III) PLANES IN COPPER

R. M. J. Cotterill and M. Doyama *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 211–217 refs (See N67-16731 07-26) HMSO: 48s

Calculations based on a model in which the atoms were treated as discrete particles are presented for vacancy clusters in copper. The particles were allowed to move independently of one another, and the forces between them were represented by a Morse potential. The calculations were of the iterative type and were carried out on a digital computer. Atoms close to the defect were found to move through relatively large distances during this process, and their displacements followed a rather irregular pattern. Atoms further away, on the other hand, underwent small and fairly symmetrical displacements, and it was found that they could be treated by elastic theory. It is also reported that the energy per cluster first rises with the number of vacancies in the cluster and then decreases, at least for the triangular and hexagonal configurations. A.G.O.

N67-16744# Max-Planck-Institut für Metallforschung, Stuttgart (West Germany). Institut fuer Physik.

BRIDGING THE GAP BETWEEN ISOLATED POINT DEFECTS AND LARGE CLUSTERS IN METALS

A. Seeger *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 218–229 refs (See N67-16731 07-26) HMSO: 48s

Techniques for studying crystal imperfections of dimensions intermediate between point defects and large clusters are summarized, and some of the results obtained by these methods are described. It is reported that reliable electron microscopy techniques are available that permit the study of cluster diameters down to about 15 Å (in copper). Results indicate that the trivacancy is rather stable, but nevertheless more mobile than single vacancies. Four-fold and probably also five-fold vacancies appear to have little stability, whereas the six-fold vacancy comes out to be very stable and to form an important nucleus for larger clusters. The most promising methods for bridging the remaining gap between small and medium clusters appear to be the diffuse scattering of X-rays or neutrons. A.G.O.

N67-16745# Reading Univ. (England). J. J. Thomson Physical Lab.

THE USE OF LONG WAVELENGTH NEUTRON SCATTERING FOR INVESTIGATING DEFECT CLUSTERS

E. W. J. Mitchell *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 230–242 refs (See N67-16731 07-26) HMSO: 48s

For wavelengths greater than the Bragg cut-off, neutrons are not scattered from a perfect crystal of coherently scattering and non-absorbing nuclei. Therefore, imperfection which can be deliberately introduced into a crystal can be studied by examining the scattering of long wavelength neutrons. A calculation of the effect of small defect clusters on scattering is demonstrated, and a case involving an interstitial defect and the relaxation of neighboring atoms is considered. It is reported that relaxation effects occur at shorter wavelengths in the total cross section than the effects of defect clusters and also show the opposite sign of wavelength dependence. A similar conclusion applies scattering by amphorous inclusions, although the detailed form clearly depends on the distribution of atoms in the inclusion. A.G.O.

N67-16746# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

THE OBSERVATION OF SMALL DEFECT CLUSTERS IN GRAPHITE AND MAGNESIUM OXIDE BY COLD NEUTRON SCATTERING MEASUREMENTS

D. G. Martin *In its* Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 243–252 refs (See N67-16731 07-26) HMSO: 48s

The shapes of the long wavelength neutron scattering cross section versus angle curves due to defects produced in graphite by neutron irradiation have been found to be similar for samples irradiated at 30°C, 200°C and 450°C respectively, and also after the 30°C sample had been annealed at temperatures up to 1100°C. By contrast, the shape of the scattering curves from MgO that has been neutron irradiated at about 200°C to doses in the range 0.7 to 200×10^{20} neutrons/cm^2 changes considerably during subsequent anneals up to 1760°C, the cross section decreasing more steeply with increasing angle the higher the annealing temperature. It is suggested that the observed scattering occurs mainly from vacancy clusters which are approximately spherical, with radii about 5Å and increasing with annealing temperature. It is also suggested that under certain conditions the dominant scattering process is from F_1 centers. Author

N67-16747# Reading Univ. (England). J. J. Thomson Physical Lab.

THE SCATTERING OF LONG WAVELENGTH NEUTRONS BY DEFECT CLUSTERS IN QUARTZ

I. H. Wilson and C. D. Clark *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 253–267 refs (See N67-16731 07-26) HMSO: 48s

Experiments to measure the change in slow neutron scattering cross-section caused by radiation damage in quartz are described. The changes in total and differential scattering cross-sections after electron and neutron irradiation are discussed and the results are compared with those calculated for a number of models of radiation damage in quartz. No point defect clusters were detected for the electron irradiation. After neutron irradiation the change in cross-section for wavelengths longer than 12 Å is the type predicted for small point defect clusters. The lower limit to the size of these clusters is ≈20 defects, and the separation between defects in the cluster is between 5 and 6 Å. Author

N67-16748# Technische Hochschule Munchen (West Germany) Institut fuer Neutronenphysik.

SMALL ANGLE SCATTERING OF NEUTRON-DAMAGED QUARTZ CRYSTALS

W. Schmatz and B. Kaiser *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 268–280 refs (See N67-16731 07-26) HMSO: 48s

The change of quartz crystals to an amphorous structure similar to quartz glass by neutron irradiation is investigated. Experiments were performed to determine the state of irradiation in which the

amphorous regions are produced. For the crystals irradiated in this study there is good evidence from neutron transmission that the amphorization starts with the beginning of irradiation, in the primary damaged zones. Results of small angle neutron scattering which confirm this conclusion are summarized. A.G.O.

N67-16749# Paris Univ., Orsay (France). Laboratory of Physics.
SMALL DEFECT CLUSTERS IN IRRADIATED LiF CRYSTALS
A. Guinier and M. Lambert. *In* United Kingdom Atomic Energy Authority. The Nature of Small Defect Clusters, Vol. 1. Sep. 1966 p 281–291 refs (See N67-16731 07-26) HMSO: 48s

Various types of defect clusters are described which were observed under different conditions of irradiation and annealing of LiF crystals. The clusters were detected and identified by means of their X-ray diffuse scattering. Consideration is given to defect structures after irradiation at 77°K and the evolution of defects with progressive annealings. It is noted that the different cluster types were found experimentally, because they are so complicated that their existence cannot be predicted a priori theoretically. A.G.O.

N67-16750# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.
THE ELECTRONIC STRUCTURE OF THREE R CENTRES IN LITHIUM FLUORIDE
A. E. Hughes. *In its* Nature of Small Defect Clusters, Vol. 1 Sep. 1966 p 292–297 refs (See N67-16731 07-26) HMSO: 48s

Three zero-phonon absorption lines in lithium fluoride were detected by applying stress to the crystal structure at liquid helium temperatures (4°K) and analyzing the absorption spectrum with polarized light. Uniaxial stress spectra are discussed and shown for lines having air wavelengths of 3909 Å, 4874 Å, and 8328 Å. The three absorption lines are interpreted as being due to a cluster of three negative ion vacancies as in Pick's model. A.G.O.

N67-16751# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE NATURE OF SMALL DEFECT CLUSTERS, VOL. 2
M. J. Makin, ed. Sep. 1966 339 p refs Rept. of a Consultants Symp., Held in Harwell, Engl., 4–6 Jul. 1966
(AERE-R-5269, Vol. 2) HMSO: 48s

Symposium papers on small point defect clusters, their observation by electron microscopy, their nature in irradiated metals and non-metals, and their effect on the mechanical properties of metals are presented. For individual titles see N67-16752–N67-16771.

N67-16752# United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.
THE ELECTRONIC STRUCTURE OF THE N_2 CENTRE
A. M. Stoneham. *In its* Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 305–313 (See N67-16751 07-26) HMSO: 48s

Many aggregates of point defects have been observed in insulators, especially in the alkali halides. Calculations are discussed concerning the N_2 center in alkali halides, which appears to the largest aggregate center to have been treated theoretically. Features common to electronic calculations for aggregates are emphasized rather than details of the particular calculation. The aims of the calculations are to predict the spin and symmetry of the ground state, to predict the energy levels of the center, and to obtain accurate electronic wave functions. The ground state gives the general features of the spin resonance spectrum and together with the energy levels gives the optical absorption spectrum. R.N.A.

N67-16753# California Univ., Berkeley. Lawrence Radiation Lab.
STRAIN CONTRAST IMAGES FROM SMALL DEFECTS
W. L. Bell, D. M. Maher, and G. Thomas. *In* United Kingdom Atomic Energy Authority. The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 314–350 refs Sponsored by AEC (See N67-16751 07-26) HMSO: 48s

The purpose of this paper is to illustrate the optimum experimental conditions necessary for obtaining strain contrast images from various types of defects. Results are discussed in terms of existing theory. Defects of known character in a number of systems have been employed. The parameters which have been considered for both the bright and dark field case are: the foil thickness, the extinction distance, the deviation parameter, the anomalous absorption parameter, defect size, defect shape, defect position in the foil, inclination of the defect with respect to the incident beam, defect density and the operating reflection. It is suggested that more detailed consideration be given to the defect model and the various parameters which affect the image characteristics in a particular crystal, and that measured parameters characteristic of the crystal by employed whenever possible, so that a closer correspondence can be established between theory and particular experimental situations. Author

N67-16754# Cambridge Univ. (England). Cavendish Lab.
DIFFRACTION CONTRAST FROM SMALL DEFECT CLUSTERS IN IRRADIATED COPPER
K. G. McIntyre and L. M. Brown. *In* United Kingdom Atomic Energy Authority. The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 351–364 refs (See N67-16751 07-26) HMSO: 48s

Computer calculations of the black–white contrast observed from small defect clusters near the surface of an electron microscope foil do not obey the "Ashby–Brown" rule, in that the sense of a line drawn from black to white depends on the depth of the defect in the foil. Since the depth of a particular defect can't be measured sufficiently accurately, statistical counts of the relative numbers of defects with black to white in the sense $+g$, and $-g$, have been made. They show that in irradiated copper the clusters are probably interstitial. Observation of a particular group of defects in two reflections with different extinction distances, comparison with systems where the sign of the defect is known, e.g. Cu–Co, and annealing experiments on the microscope foils support this conclusion. Author

N67-16755# Max-Planck-Institut fur Metallforschung, Stuttgart (West Germany). Institut fuer Physik.
OBSERVATIONS OF POINT DEFECT AGGLOMERATIONS IN COPPER BY MEANS OF ELECTRON MICROSCOPY
M. Wilkens and M. Ruehle. *In* United Kingdom Atomic Energy Authority. The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 365–383 refs (See N67-16751 07-26) HMSO: 48s

Summarized are results of studies on point defect agglomerations in copper. Emphasized is the nature of the damage by fast neutrons and by high-energy ions inside the electron microscope. Experimental observations on the so-called black–white contrast, which some of the lattice defects may reveal under dynamical two-beam diffraction conditions, are listed. It is shown that the majority of the defects are Frank sessile dislocation loops on {111} -planes. Contrast theory shows that the direction of the black–white contrast is opposite for vacancy and interstitial loops, and is the reverse for loops with distances from the surface smaller than about 0.3 of the extinction length ξ_g compared with loops at a distance of about 0.5 ξ_g (depth oscillations). For a complete contrast analysis it is thus essential to measure the depth of the defect location with an accuracy better than ≈30Å. This has been done by stereo electron microscopy and—less directly—by changing the operating diffraction vector between two subsequent photographs of the same foil area. According to our results the

Frank loops generated by fast neutrons and by ions with energies of 40 keV or 100 keV are of vacancy type. Additional results are reported regarding the analysis of the diffraction contrast caused by the damage in copper by 5 keV argon ions, by polishing defects in copper, and by small vacancy agglomerations in quenched gold. Author

N67-16756# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

THE INFLUENCE OF IRRADIATION TEMPERATURE ON THE DAMAGE STRUCTURE IN NEUTRON IRRADIATED MOLYBDENUM

B. L. Eyre and M. E. Downey *In its* Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 384–394 refs (See N67-16751 07-26) HMSO: 48s

A thin film electron microscope study has been made of a commercial purity and a zone refined molybdenum neutron irradiated to a dose of 5×10^{19} n.cm^{-2} at 60°C and 200°C. Visible damage clusters are present in all of the specimens, but they are more coarsely distributed in the purer material and after irradiation at the higher temperature. In the case of the zone refined material irradiated at 200°C the damage is distinguishable as two components; coarsely distributed irregular dislocation lines and a finer distribution of small dots up to 50Å in diameter. The results of loop analysis carried out on annealed specimens indicate that the small dots are vacancy clusters. Dark field analysis was carried out on the small clusters showing asymmetrical contrast in the zone refined material irradiated at 60°C and 200°C. The results indicate that these clusters at least are small loops. Author

N67-16757# Cambridge Univ. (England). Dept. of Metallurgy.

DIRECT OBSERVATIONS OF SMALL DEFECT CLUSTERS IN IRRADIATED METALS BY FIELD-ION MICROSCOPY

B. Ralph, M. A. Fortes, and K. M. Bowkett *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 395–404 refs Sponsored by United Kingdom Atomic Energy Authority (See N67-16751 07-26) HMSO: 48s

The discussion focuses on clusters of vacant sites introduced into specimens by clusters 35 Å in diameter found in tungsten after irradiation with fission fragments, and by smaller clusters found after neutron irradiation of bulk specimens of iridium and tungsten. Three distinct types of large clusters have been found in reactor irradiated iridium after irradiation to 10^{13}–10^{14} n.v.t. The first contained up to 200 single vacancies and appeared in a compact, nearly spherical form, while larger clusters collapsed to give dislocation loops. The third type consisted of a dispersion of single vacancies in a small volume such that about 30–40% of the lattice sites in this volume were unoccupied. Studies of neutron irradiated tungsten have been directed at determining the migrating species especially in stage III annealing. The field-ion evidence shows that single vacancies are migrating to form divacancies and small clusters. Author

N67-16758# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

THE EFFECT OF IRRADIATION TEMPERATURE ON THE FORMATION OF CLUSTERS IN NEUTRON IRRADIATED COPPER

G. P. Scheidler, W. F. Schilling (Kernforschungsanlage), M. J. Makin, and F. J. Minter *In its* Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 405–418 refs (See N67-16751 07-26) HMSO: 48s

Studies have been made of the density of defect clusters of various sizes, as observed at 20°C by transmission electron microscopy, after irradiation at 4°, 77°, 293° and 378°K. The results that a different size distribution of defects is formed during equal dose irradiations at 4°K, as compared with 293°K; and also at 77°K as compared with 378°K. In each case the density of clusters below 75 Å in diameter is much greater after the lower temperature irradiation, and the density of the larger clusters (>75 Å) is smaller. This result is discussed in terms of the effect of irradiating below and above the temperature at which interstitial atoms become mobile. Author

N67-16759# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.

HEAVY ION DAMAGE IN COPPER

R. V. Hesketh and G. K. Rickards *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 419–432 refs (See N67-16751 07-26) HMSO: 48s

While the damage created by fast neutrons and heavy ions differs from metal to metal, different results on one metal are also reported. An effort has been made to discard differences of antiemphyteutical origin. It is suggested that in copper bombarded at 300°K one sees by electron-microscopy simply the vacancy cascades, the small ones having remained three dimensional and the large ones having collapsed to dislocation loops. Author

N67-16760# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.

CLUSTERS IN ION BOMBARDED ALUMINIUM AND NICKEL

D. I. R. Norris *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 433–440 refs (See N67-16751 07-26) HMSO: 48s

Defect clusters formed by the room temperature bombardment of aluminium and nickel with 150 keV xenon ions have been studied by electron microscopy. In aluminium orientations of black–white images suggest that both sessile and prismatic loops are present; three-dimensional clusters of a similar number of point defects would be below the visibility limit. The attenuation length of the damage in aluminium in a direction close to [112] is 1000 Å. The largest loops are formed from about 400 point defects in aluminium and about 300 in nickel. These results are compared with the sizes of displacement cascades. The directions of black–white images in an aluminium foil bombarded with 15 keV mercury ions, the majority of which penetrate less than a quarter of an extinction distance into the foil, suggest that the clusters are of vacancy character. Author

N67-16761# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.

CLUSTERS IN IRRADIATED ZIRCONIUM

I. M. Bernstein and T. D. Gulden *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 441–445 refs (See N67-16751 07-26) HMSO: 48s

Observations of damage in thin foils of zirconium irradiated with krypton ions are reported. It is shown that large dislocation loops can be formed in krypton ion irradiated and annealed zirconium. The loops are fault-free, interstitial in nature and form three discrete sets on or near the prism planes, each having a particular a/3 $<11\bar{2}0>$ Burgers vector. Results constitute the first detailed analysis of radiation induced dislocation loops in a hexagonal metal. S.C.W.

N67-16763# United Kingdom Atomic Energy Authority, Harwell (England). Ceramics Div.

CAVITY FORMATION IN NEUTRON-IRRADIATED MAGNESIUM OXIDE

D. H. Bowen *In its* Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 461–467 refs (See N67-16751 07-26) HMSO: 48s

Preliminary measurements of lattice parameter, density and macroscopic growth as a function of annealing temperature are presented for MgO single crystals irradiated to a dose of 8.8×10^{20} nvt. The irradiation-induced lattice parameter change becomes negative above 1100°C but recovery of the lattice parameter to the unirradiated value occurs between 1450°C and 1800°C. The density curve shows a discontinuity at ≈1500°C and another at ≈1625°C. These effects are interpreted in terms of a condensation of irradiation-induced vacancy clusters into rectilinear cavities. Author

N67-16765# Birmingham Univ. (England). Dept. of Physical Metallurgy.

KINETICS OF DISLOCATION CLIMB

P. S. Dobson and R. E. Smallman *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 480–490 refs (See N67-16751 07-26) HMSO: 48s

The climb of dislocation loops, both prismatic and faulted, in thin aluminum metal foils was studied to determine whether the process is diffusion controlled. Reported are results of several independent experiments which were designed to test the validity of the following general predictions: (a) changes in the loop to vacancy sink distance will alter the climb rate; (b) at large loop sizes ($r \geq t$) the shrinkage rate depends on the depth in the foil; (c) as the loop size decreases the shrinkage rate increases, and the rate is independent of the depth of the loop in the foil. The effect of the sink to loop distance was demonstrated by studying the climb behavior of loops in the vicinity of internal sinks. To test the depth dependence of the climb rate of large dislocation loops, aluminum foils containing a number of large faulted loops were annealed in a constant temperature bath. Measurements of loop radius as a function of annealing time showed that the shrinkage rate varied by about 10% over a number of loops. To determine the influence of loop size on shrinkage rate it was necessary to obtain the complete annealing curve for a large faulted loop. Results indicated that the complete annealing curve can be described in terms of a diffusion controlled rate process where the diffusion geometry is changing from cylindrical diffusion for large loops to spherical diffusion for small loops. S.C.W.

N67-16766# Max-Planck-Institut für Metallforschung, Stuttgart (West Germany). Institut fuer Sondermetalle.

ANNEALING OF THE VACANCY AGGLOMERATES RESPONSIBLE FOR THE ENHANCEMENT OF THE CRITICAL SHEAR STRESS OF NEUTRON IRRADIATED NICKEL

J. Diehl and D. Ast *In* United Kingdom Atomic Energy Authority The Nature of Small Defect Clusters, Vol. 2 Sep. 1966 p 491–502 refs Sponsored by Bundesministerium fuer Wiss. Forsch. (See N67-16751 07-26) HMSO: 48s

The critical shear stress (CSS) increase in neutron irradiated nickel is caused by vacancy agglomerates which act as dislocation obstacles. The annealing behavior of the CSS in the temperature range in which the dislocation obstacles disappear was studied. Details of the annealing treatment, results expressed in an isochronal annealing curve of the CSS, the methods used to determine the activation energy of the annealing process, the annealing kinetics, and the temperature dependence of the CSS are discussed. It is shown that the vacancy agglomerates responsible for the CSS are dissolved by a process localized at them and does not involve any interaction between different agglomerates. The observation that after partial annealing remaining agglomerates are unchanged in size leads to the conclusion that the agglomerates disintegrate spontaneously. The agglomerates dissolve by splitting-off of single or multiple vacancies which migrate to sinks in the lattice, since their splitting-off energy is always smaller than the activation energy for the splitting-off from the agglomerates. The activation energy decreases with decreasing size of the agglomerates, therefore, the first splitting-off determines the reaction rate. R.N.A.

N67-16858# Polytechnic Inst. of Brooklyn, N. Y.

ELECTROCHEMICAL BEHAVIOR OF OXIDE FILMS ON SEMICONDUCTORS

F. C. Collins, M. Schrager, R. Poignant, and C. Chiang *In its* Res. on Electromagnetics for Proj. DEFENDER 30 Sep. 1966 p 267–268 (See N67-16824 07-25) CFSTI: HC $3.00/MF $0.65

Studies of transport processes in the thermal growth of semiconductor oxide films and of ionic migration in oxide films in the range 50° to 250°C are discussed. It is reported that models are constructed and show that the coupled ionic and electronic transports are related separately to the electrostatic and Fermi potential gradients in the film. In the ionic migration area Poisson–Boltzmann equations were extended in calculations of the ionic distributions in metal oxide semiconductor devices. C.T.C.

N67-16936# Rutgers Univ., New Brunswick, N. J. Physics Dept.

STUDIES OF FILMS IN THE SUPERCONDUCTIVE AND NORMAL PHASES Final Report, Jul. 1, 1962–Jun. 30, 1966

Bernard Serin Nov. 1966 15 p refs

(Contract DA-36-039-SC-90821)

(ECOM-90821-F; Rept.-16; AD-641992) CFSTI: HC $3.00/MF $0.65

The current carrying capacity of double layer films consisting of two different superconductors was studied. After aging (which probably entails the formation of intermetallic compounds), an intermediate zone displayed hard superconductor behavior. It was for the first time demonstrated that a magnetic field perpendicular to a superconducting film penetrates the film spotwise, each spot containing one quantum of magnetic flux. This effect was studied with alloy films of varying composition to determine how the Ginzburg-Landau parameter of the superconductor changes with temperature. This parameter roughly indicates the hardness of a superconductor and thus its technical usefulness. The thermal conductivity of films was studied to clarify the behavior of the electronic system as a function of temperature and of the magnetic field. Author (TAB)

N67-16948# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Metallurgy and Ceramics Research Lab.

STUDIES OF SURFACE LAYER TRANSPORT AND ITS CONTRIBUTIONS TO THE PROPERTIES OF CERAMIC MATERIALS

Henry C. Graham and Norman M. Tallan *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 36 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

A study is made of the particle size dependence of the conductivity for the normally slower moving chlorine ion in NaCl. It is shown that the chlorine ion conductivity can become more significant than sodium ion conductivity in ultra-fine grained materials. The enhancement is reciprocally dependent upon grain size indicating that the enhanced chlorine movement is in a subsurface region as proposed previously. The accepted Schottky energy is shown to be high by 0.4 eV, (1.77 instead of 2.12 eV). This difference is the direct result of assuming that the total intrinsic conductivity or diffusivity is sodium ion movement, whereas this study shows that the chlorine ion contributes significantly to this total intrinsic conductivity. The significance of the results is discussed with respect to being able to accurately predict and control essential fabrication processes and application properties of ceramic materials. Author

N67-16953# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

LASING POTENTIAL OF II–VI COMPOUNDS

Donald C. Reynolds *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 33 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

Compounds prepared from elements of group II and group VI of the periodic table show great promise for laser operation at any wavelength between 7772Å (CdTe) and 3200Å (ZnS). Currently lasers operating at 4900Å (CdS) and 6900Å (CdSe) have been successfully produced. In addition compounds of the solid solutions CdS:Se have successfully demonstrated laser action allowing one to have lasers at any wavelength between 4900Å and 6900Å. The spectral region covered by II–VI compounds is the region in which the highest sensitivity has been achieved for detectors. This increases the potential for many practical applications. Author

N67-16971# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

CURRENT AND LIGHT STORAGE EFFECTS IN LITHIUM AND SODIUM DOPED CRYSTALS OF ZnO

Yoon Soo Park and Cole W. Litton *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1968 25 p refs (See N67-16962 07-34) CFSTI: HC$3.00/MF$0.65

The phenomena of mechanical excitation of fluorescence and current storage have been observed in Li- and Na-doped ZnO single crystals following optical or thermal stimulation of a sample at 77°K. Na-doped crystals possessed a good current storage property and gave mechanically excited emission only after optical stimulation; Li-doped crystals, on the other hand, did not show a current storage property and responded to mechanical tapping only after thermal stimulation. The threshold for optical stimulation of hole storage was found at a wavelength of 3680Å. The depth of the hole storage level lies 0.06 eV above the valence band. Strong, blue–green edge fluorescence can also be triggered by infrared light in an optically stimulated sample. Author

N67-16972# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

ELECTRICAL AND MAGNETIC PROPERTIES OF SINGLE CRYSTALS OF RARE EARTH TUNGSTEN BRONZES AND URANIUM TUNGSTEN BRONZES

Charles V. Collins *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1968 26 p refs (See N67-16962 07-34) CFSTI: HC$3.00/MF$0.65

Rare earth tungsten bronze single crystals were prepared by the method of electrolysis. $Sm_{.09}WO_3$ and $Gd_{.19}WO_3$ crystals were grown from a melt of rare earth chloride and tungsten trioxide at temperatures ranging from 1050°C to 1300°C. Sodium tungsten bronze single crystals, Na_xWO_3, with x ranging between .37 and .81 were also prepared. These crystals were grown from melts of fused sodium tungstate, tungsten trioxide, and tungsten at temperatures from 700°C to 900°C. Powder samples of a new tungsten bronze, uranium tungsten bronze, were also synthesized. Samples were investigated by X-ray diffraction, magnetic, and electrical conductivity measurements. The metallic nature of the cubic rare earth uranium tungsten bronzes was observed. Because the tungsten bronzes are light in weight and have electrical properties that can be varied, they may have application in airborne equipment where weight is an important consideration. Author

N67-16973# Air Force Cambridge Research Labs., Bedford, Mass.

DIELECTRIC RESONATORS

James C. Sethares and Martin R. Stiglitz *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1968 29 p refs (See N67-16962 07-34) CFSTI: HC$3.00/MF$0.65

High-dielectric-constant, low-loss dielectric crystals, such as rutile and strontium titanate, can be made to resonate at microwave frequencies, and thus find application in microwave technology, wherever conventional metallic microwave resonators are used. This paper deals with rutile and strontium titanate crystals used as microwave filters, and the frequency tuning and stabilization of dielectric resonators. An analogy between high dielectric crystals and a water drop is presented for the purpose of possible rain drop size measurements. An analysis of the filter and tuned resonators, based on equivalent electrical networks, is made and the predictions of the analysis supported by experimental evidence. Author

N67-17006# Columbia Univ., New York. Dept. of Electrical Engineering.

FERROELECTRICS AT MICROWAVE FREQUENCIES

V. L. Granatstein, R. Rennick, B. Simmons, and P. Korn *In its* Surface Wave Guiding and Radiating Systems Jun. 1966 p 10–12 refs (See N67-17001 07-25) CFSTI: HC$3.00/MF$0.65

Several of the characteristics of soft and hard ferroelectrics are briefly mentioned, and some of the research and testing conducted on ferroelectrics is summarized. A brief description is also given of testing of samples of 36% Ba TiO_3, 14% $SrTiO_3$, and 50% $CaTiO_3$. L.E.W.

N67-17038# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.

SURFACE OXIDE FILMS AND THE LIFE TIME OF VACANCIES IN THIN CRYSTALS

G. Thomas (Calif. Univ., Berkeley) and A. Elkum Aug. 1966 15 p refs Submitted for Publication Supported in Part by AEC (D1-82-0561; AD-641126) CFSTI: HC$3.00/MF$0.65

During annealing experiments in the electron microscope, prismatic dislocation loops and helices have been observed to grow in thin foils prepared from quenched and aged samples of supersaturated aluminum-magnesium alloys. Growth in pure aluminum or dilute aluminum-magnesium alloys has not been reported. It has been suggested recently that the excess vacancies required for growth are residual quenched-in vacancies which were not able to sink at external surfaces due to the presence of an impervious oxide film. The oxide mechanism fails to account for the fact that growth has not been observed in pure aluminum and dilute aluminum alloys. This point and others concerning the life time of vacancies in thin crystals are discussed. Author (TAB)

N67-17171# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MECHANISM OF RADIOLUMINESCENCE OF ALKALIHALIDE PHOSPHOR CRYSTALS

T. A. Soovik *In its* J. of Appl. Spectry. 31 Aug. 1966 p 10–16 refs Presented at the 12th Conf. on Luminescence, Lvov, Jan. 1964 (See N67-17169 07-16) CFSTI: HC$3.00/MF$0.65

The causes of the great difference in the scintillation efficiency of members of the homologous series KI–Tl, KBr–Tl, and KCl–Tl are discussed. For these phosphors, experimental data are presented on the yield of stationary luminescence, optically excited in the zone-to-zone transition region and in the long wave exiton absorption band, on the relative scintillating efficiency. For KI–Tl, the dependence of these quantities on the concentration of the activator, and the nature of the kinetics of photo- and cathode-luminescence are found. The facts presented are considered as strong evidence in favor of the important role of exiton processes in the phenomenon of scintillation in activated potassium halides. Author

N67-17192# George Washington Univ., Washington, D. C. School of Engineering and Applied Science.

MEASUREMENTS OF THE THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF PLATINUM FROM 373 TO 1373°K Final Report

Malcolm E. O'Hagan and Robert B. Heller Sep. 1966 8 p refs
(Grant AF-AFOSR-1025-66)
(AFOSR-66-2484; AD-642245)

Measurements were made of the thermal conductivity and the electrical resistivity of commercial grade platinum (99.987 per cent pure) in the temperature range 373 to 1373K. The measurements were made with a view to providing accurate data on the thermal conductivity of platinum to serve as a basis for establishing platinum as a thermal conductivity standard reference material. The data obtained agree within experimental error and show the thermal conductivity of platinum to be a smoothly increasing function of temperature in the measured range. The data are considered to be accurate to better than one percent. TAB

N67-17239# Pennsylvania State Univ., University Park. Ordnance Research Lab.
AN INVESTIGATION OF EXO-ELECTRON EMISSION FROM VARIOUS MATERIALS USING ABRASION AND ULTRASONIC TECHNIQUES
R. A. Williams 3 Oct. 1966 73 p refs
(Contract NOw-65-0123-d)
(TM-630.3281-04; AD-642422) CFSTI: HC $3.00/MF $0.65

Exo-electron emission is the emission of electrons from materials which have been subjected to structural deformation. Brief descriptions of previous investigations, models and theories are given. Experimentally the phenomenon was investigated using the following materials: aluminum, brass, copper, stainless steel, cold rolled steel, columbium, lead, and nickel. An attempt to enhance the emission from aluminum 6061 was made using various stimuli. These stimuli include different abrasion methods, temperature variation, and ultrasonic irradiation. All of these stimuli were able to produce emission increases, but for prolonged emission a continual deformation appears necessary. The results of the investigation are discussed in relation to a number of theories and models. Satisfactory agreement between models was found, but a model involving a vacancy diffusion process appears most plausible. Author (TAB)

N67-17244# Army Electronics Labs., Fort Monmouth, N. J.
AN INTERFEROMETRIC EFFECT WITH SEMICONDUCTORS IN THE MILLIMETER WAVE REGION
Harold Jacobs, George Morris, and Ronald Hofer Oct. 1966 32 p refs
(ECOM-2774; AD-642573) CFSTI: HC $3.00/MF $0.65

Calculations and experiments have been carried out relating to multiple internal reflections of millimeter waves in semiconductors for a specific system composed of air, a semiconductor panel, an air gap, and a metal reflector. If the thickness of the semiconductor and air gap is chosen at critical values, and if the conductivity of germanium is chosen properly, it is found that complete absorption will result and no reflection occurs. Next in these types of systems, the semiconductor conductivity can be varied electronically, i.e., injection of excess free carriers by light, by electron bombardment, or by current being carried across a junction. Changes in conductivity result in variations in reflected power. The sensitivity of such a system opens up the possibility of a new family of devices for instruments for physical measurements and quasi-optical systems. Three examples of new devices are described as follows: (1) a device for amplitude modulation of millimeter and submillimeter waves; (2) an interferometer for measurement of wavelength in this region; (3) an approach for conversion of millimeter and submillimeter wave images into visual displays. Author (TAB)

N67-17277 Baird-Atomic, Inc., Cambridge, Mass.
CIRCULARLY POLARIZED LASER MODES IN RUBY
J. Kaplan and J. Goldstein *In its* Res. on Circularly Polarized Lasers and Their Use 31 Jul. (See N67-17274 07-16)

The optical properties of the ruby laser material $Al_2O_3Cr^{+3}$ are examined, and an energy level diagram for this material is presented. Such areas as the effects of the cubic field, the axial field, and spin-orbit interaction are indicated on the diagram. Zeeman splitting and the transiton probabilities for different orientations and polarizations are also discussed. Finally, the effect of operating a ruby laser in a pure circularly polarized mode is considered. S.P.

N67-17279 Baird-Atomic, Inc., Cambridge, Mass.
ALIGNMENT OF Cr^{3+} IN RUBY
G. F. Hull, Jr., J. T. Smith, and A. F. Quesada *In its* Res. on Circularly Polarized Lasers and Their Use 31 Jul. 1966 4 p refs Repr. from Appl. Optics, v. 4, no. 9, Sep. 1965 p 1117-1120
(See N67-17274 07-16)

Alignment of Cr^{3+} in ruby has been accomplished by optically pumping a ruby sample with circularly polarized radiation, 6943 Å, from a high-power ruby laser. Alignment of Cr^{3+} is detected by the emf induced in a coil surrounding the ruby sample. Measurements of the percentage alignment and relaxation time of Cr^{3+} are obtained from oscillograms of the induced emf and of the circularly polarized radiation from the ruby laser. At room temperature the efficiency of alignment is several tens of percent and the relaxation time of Cr^{3+} is about 1.0 μsec. Author

N67-17373# Naval Research Lab., Washington, D. C.
DETECTOR INVESTIGATION FOR 8–15 AND 100–4000 MICRON REGIONS Semiannual Technical Summary Report, 1 Jan.–30 Jun. 1966
R. F. Wallis and H. Shenker Jul. 1966 57 p refs
(ARPA Order 269-62; Proj. DEFENDER)
(NRL-MEMO-1712; Rept.-20; AD-639223) CFSTI: HC $3.00/MF $0.65

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3. MATERIALS PREPARATION p 13–36 refs

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N67-17374# Naval Research Lab., Washington, D. C.
MAGNETOOPTICAL STUDY OF HYDROGENIC DONOR IMPURITY STATES IN InSb
R. Kaplan *In its* Detector Invest. for 8–15 and 100–4000 Micron Reg. Jul. 1966 p 37–52 refs (See N67-17373 07-26)
CFSTI: HC $3.00/MF $0.65

The spectral dependence of the optical absorption and photoconductivity due to hydrogenic donor impurities in InSb has been studied as a function of temperature and magnetic field. Transitions from the impurity ground state to three discrete excited states and to the first Landau level have been observed. The detailed experimental results are in agreement with theoretical predictions concerning the magnetooptical absorption spectrum of hydrogenic atoms in a strong magnetic field. Author

N67-17403# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
RADIATION INDUCED ELECTRICAL PHENOMENA IN ORGANIC DIELECTRICS
W. A. Smith, Jr. Jun. 1966 56 p refs
(Contract AT(29-1)-1183)
(EGG-1183-2096; S-336-R) CFSTI: HC $3.00/MF $0.65

The general aspects of radiation effects in solid and liquid polymers are reviewed, and an attempt is made to identify the major electrical effects induced in a polymeric-type organic insulator used in a device for measuring flux in a high-intensity gamma field. Primary and secondary energy-transfer processes are characterized, and measurements of various material properties before, during, and after irradiation are described and interpreted with respect to radioinduced conductivity. Specific recommendations are made in several areas directly related to the problems of calculating sensitivities of gamma detectors and understanding their electric behavior. Author (NSA)

N67-17405# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.

SINTERING STUDIES AND PHASE CHARACTERIZATION IN THE SYSTEM Eu_2O_3–UO_2

H. W. Hill, J. E. Lewis, and L. N. Grossman Jan. 1966 30 p refs

(Contract AT(04-3)-189)

(GEAP-5008) CFSTI: HC $3.00/MF $0.65

The sintering behavior of Eu_2O_3–UO_2 compositions containing 0 to 10 wt% Eu_2O_3 was studied in hydrogen atmospheres at 1550, 1650, and 1750°C. It was found that Eu_2O_3 inhibits densification in the binary oxide system; inhibition is most pronounced at the lower temperatures. At 1750°C, densities above 95% of theoretical were attained. X-ray-fluorescence techniques were employed for the analysis of compositional uniformity in the sintered specimens. The sintered samples were characterized for phase structure by X-ray-diffraction techniques; only the fluorite phase was detected. Phase equilibria in the Eu_2O_3–UO_2 system were determined by high-temperature thermal analysis and X-ray diffraction on specimens containing between 0 and 56.6 wt % Eu_2O_3. A partial phase diagram is given. The lattice parameter of the fluorite phase decreases linearly from 5.4707 Å for pure UO_2 to 5.400 Å for 57.5 mole % $EuO_{1.5}$. Author (NSA)

N67-17407# Brookhaven National Lab., Upton, N. Y.

CHANNELING AND RELATED EFFECTS IN THE PASSAGE OF CHARGED PARTICLES THROUGH CRYSTAL LATTICES

Cavid Erginsoy Aug. 1966 31 p refs Presented at Solid State Conf. on Interaction of Radiation with Solids, Cairo

(Contract AT(30-2)-GEN-16)

(BNL-10544; CONF-660923-2) CFSTI: HC $3.00/MF $0.65

Under certain conditions in a crystalline solid the impact parameters of successive collisions of energetic ions may become correlated and their distribution is not random. Hence, the yield of the same reaction for a given pathlength of the ion may depend strongly on direction. Some aspects of the theory of such directional effects are discussed in terms of channeling and blocking experiments, average potentials for atom rows and planes, multiple scattering of particles into channels, correlated motion of particles with small impact parameters, channeled particles, and use of directional effects in solid state physics. NSA

N67-17456# Iowa State Univ. of Science and Technology, Ames. Dept. of Physics

GREEN'S FUNCTION METHOD FOR ANTIFERROMAGNETISM

Keum Hwi Lee (Ph.D. Thesis) Aug. 1966 180 p refs

(Contract W-7405-ENG-82)

(IS-T-99) CFSTI: HC $3.00/MF $0.65

Cubic antiferromagnets with isotropic, nearest-neighbor, Heisenberg interactions are studied for general spin and temperature by using two-time temperature-dependent Green's functions of the spins and the Callen's decoupling scheme. It is shown that the energy spectrum and the sublattice magnetization as functions of temperature are the solutions of a set of coupled equations. The equations are solved numerically for $S=1/2$ and the results compare very well with the existing theories in both high- and low-temperature limits. The Néel temperature is also calculated for general spin. Compared with other theoretical estimations, the Néel temperature obtained this way is appreciably higher for $S=1/2$, but approaches agreement in the large spin limit. The transverse correlation functions of the spins and the correlation length above the Néel temperature are calculated. Liu's method of calculating the longitudinal correlations function for ferromagnetism is extended to antiferromagnetism. A calculation is carried out for $S=1/2$ using the Callen's decoupling scheme. It is shown that the longitudinal correlation function is related to the first order response of the system to a space and time varying field. A satisfactory extension of Callen's decoupling scheme to first-order equation is found. The extended decoupling scheme leads to the following desirable results: rotational invariance of the correlation functions and susceptibilities at and above the Néel temperature and the validity of sum rules for spin operators over the same temperature range. The parallel susceptibility is also calculated as well as the internal energy and the specific heat above the Néel temperature. Numerical calculations of parallel and perpendicular susceptibilities for $S=1/2$ are carried out and the results are presented. Author (NSA)

N67-17475# Sandia Corp., Albuquerque, N. Mex.

SHOCK COMPRESSION OF POROUS MAGNETITE

Robert C. Bass Oct. 1966 10 p refs

(Contract AT(29-1)-789)

(SC-RR-66-547) CFSTI: HC $3.00/MF $0.65

Shock compression experiments were conducted on porous magnetite (Fe_3O_4). Sample density of 2.91 gm/cm^3 was maintained. Results are compared to a synthesized Hugoniot for solid magnetite. Values are estimated for the Grüneisen parameter and temperature along the Hugoniot. Author (NSA)

N67-17480# Los Alamos Scientific Lab., N. Mex.

RESONANT ABSORPTION BY IMPURITY ATOMS NEAR CRYSTAL SURFACES

Marvin Rich Mar. 1966 72 p refs

(Contract W-7405-ENG-36)

(LA-3537) CFSTI: HC $3.00/MF $0.65

Quantities pertaining to the resonant absorption of γ rays by a substitutional impurity atom located near the surface of a simple cubic lattice are considered. The lattice model utilizes central and noncentral harmonic nearest neighbor interactions that decouple the motions in the three principal directions. Recoilless fractions, second order Doppler shifts, and phonon decompositions of the impurity motion are presented as functions of impurity mass and coupling and lattice temperature for equal and unequal central and noncentral forces. The surface asymmetry of the recoilless fraction and the one-phonon spectra which occurs in the unequal force case, but not for equal compressional and shear forces, are also examined. Author (NSA)

N67-17507*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MECHANISM OF CADMIUM SULFIDE FILM CELL

Andrew E. Potter, Jr. and Rose L. Schalla Washington, NASA, Feb. 1967 15 p refs

(NASA-TN-D-3849) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The cadmium sulfide film cell is a barrier-layer cell formed by a surface layer of chalocite (Cu_2S) on cadmium sulfide (CdS). The chalocite is a very degenerate p-type semiconductor with the Fermi level 1 to 3 electron volts below the valence band edge. The barrier height of the junction is about 0.85 electron volt. The spectral response of the cell in monochromatic light for photon energies greater than 2.4 electron volts (the blue response) is

ascribed to direct excitation across the band gap of cadmium sulfide plus photoelectric emission from the barrier layer. The response for photon energies less than 2.4 electron volts (the red response) is ascribed solely to photoelectric emission from the chalcocite layer. The efficiency of this process is greatly affected by surface damage and surface impurities. After heat treatment, the spectral response can be altered by illuminating the cell with constant-intensity blue or red light during the spectral-response measurements. (This is not the case before heat treatment). This effect is ascribed to impurities in the cadmium sulfide introduced from the copper sulfide layer by the heat treatment. Author

N67-17561# Oak Ridge National Lab., Tenn.
PHOTOELECTRIC AND OPTICAL PROPERTIES OF COMMERCIAL PLATINUM, GOLD AND PALLADIUM FOILS AND EVAPORATED ALUMINUM AND SILVER FILMS IN THE EXTREME ULTRAVIOLET
J. L. Stanford (Ph.D. Thesis—Tenn. Univ.), E. T. Arakawa, and R. D. Birkhoff Sep. 1966 114 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1392) CFSTI: HC $3.00/MF $0.65

The purpose of the work reported was to extend photoelectric measurement on Ag and Al under good vacuum conditions into the ultraviolet region beyond the LiF cutoff in order to obtain, with a knowledge of the optical properties of these metals, information about mean free paths of electrons with energies of the order of 10 ev above the Fermi level and the scattering processes in which they are involved. In order to develop the proper methods and equipment for obtaining photoemission data, initial measurements were made on commercial foils of Pt, Au, and Pd for which data was available in the literature. NSA

N67-17576# California Univ., Berkeley. Lawrence Radiation Lab.
A CALORIMETRIC INVESTIGATION OF SUPERCONDUCTIVITY IN α-URANIUM
Norman E. Phillips, James C. Ho, and T. F. Smith Jul. 1966 9 p refs Presented at 10th Intern. Conf. on Low Temp. Phys., Moscow, 31 Aug.–6 Sep. 1966 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-17026; CONF-660816-3) CFSTI: HC $3.00/MF $0.65

Although the occurrence of superconductivity in alpha uranium is of particular interest in connection with the role of the 5f states, the relevant experimental evidence is contradictory. To gain more information about the superconductivity of alpha uranium heat capacity measurements were made at zero pressure and at 10 kbar. NSA

N67-17578# Iowa State Univ. of Science and Technology, Ames.
FREQUENCY DEPENDENCE OF THE MAGNETIZATION OF HOLMIUM IN THE NEIGHBORHOOD OF THE FERROMAGNETIC ORDERING TEMPERATURE
Farley Olander (Ph.D. Thesis) May 1966 54 p refs
(Contract W-7405-ENG-82)
(IS-T-108) CFSTI: HC $3.00/MF $0.65

From frequency dependence studies of polycrystalline holmium, the form of the complex susceptibility as a function of frequency in the range 20–110 cps was determined. It was found that above 20 cps the susceptibility is being measured above the resonance frequency, which means that a-c susceptibility results above 20 cps will not agree with static susceptibility results. It was found that measurable losses occurred at all experimental frequencies. A model was established to relate the susceptibility to the domain wall displacement. From this it was hoped that the damping parameter could be determined. It was found that the model was inconsistent with the experimental data. The possibility of any time dependence of the isothermal susceptibility in the vicinity of the Curie point was investigated. From the results it was concluded that there is no kinetic effect present. Author (NSA)

N67-17596# California Univ., Berkeley. Lawrence Radiation Lab.
SURFACE IONIZATION OF CESIUM AND THERMIONIC EMISSION FROM PLANAR SINGLE CRYSTALS OF TUNGSTEN
Daniel René Koenig (Ph.D. Thesis) Jun. 1966 305 p refs
(Contract W-7405-ENG-48)
(UCRL-11857) CFSTI: HC $3.00/MF $0.65

The thermal emission of electrons, and cesium atoms and ions from two large ($\approx$0.5 cm^2), flat, monocrystalline, tungsten surfaces oriented in the [100] and [110] crystallographic directions was investigated. All experimental results were obtained by measuring the current-voltage-time characteristics of two diodes, each having one of the tungsten single crystals for the cathode (emitter). A guard ring in the plane of the collector ensured accuracy of the current measurements. The work function ϕ_0 of each crystal surface was determined from measurements of the field-free thermionic emission in vacuum in the temperature range 1400 to 2200°K. The desorption energies ϕ_{io} and ϕ_{ao} of cesium ions and atoms, respectively, evaporating from the (essentially) bare crystal surfaces were determined from measurements of the evaporation rates of these particles in the temperature range 1000 to 1500°K. The change in the work function of each crystal surface due to adsorption of cesium was evaluated from measurements of both the field-free electron and cesium-ion emissions in the surface-temperature range 850 to 1450°K and the cesium-reservoir temperature range 0 to 100°C. Excellent agreement was found between these two independent determinations. Much of the data obtained from the (110) crystal exposed to cesium could not be confidently related to the vacuum data because the crystal surface was believed to have become contaminated. The flux of cesium vapor in equilibrium with its condensed phase was measured in the temperature range 0 to 120°C. Author (NSA)

N67-17647# Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.
RESEARCH ON SURFACE PHENOMENA AND DIFFUSION IN SOLIDS Annual Summary Report, 1 Oct. 1965–30 Sep. 1966
Paul G. Shewmon 30 Sep. 1966 3 p
(Contract Nonr-760(19))
(AD-640920) CFSTI: HC $3.00/MF $0.65

A brief outline is presented of research being conducted on the mobility of the interface between a solid precipitate and the solid matrix in which it is growing. The work is being done in two component systems where the interface can be moved simply by raising the temperature. The object is to quickly jump the temperature to a new constant value and observe the rate of solution or growth of the precipitate by following the electrical resistivity of the matrix. Also included are two abstracts of work completed on the effect of adsorbed sulfur on the surface self-diffusion of copper, and the adsorption of sulfur on copper. R.N.A.

N67-17649# Marine Engineering Lab., Annapolis, Md.
SUPERCONDUCTIVITY AND LONG RANGE ORDERING IN A15-TYPE STRUCTURES
E. C. Van Reuth, R. D. Blaugher (Westinghouse Elec. Corp., Baltimore), R. M. Waterstrat (Natl. Bur. of Standards, Washington, D. C.), R. A. Hein, and J. E. Cox (NRL) Sep. 1966 13 p refs Prepared in Cooperation with Westinghouse Elec. Corp., Natl. Bur. of Standards, and NRL
(MEL-458/66; AD-642028) CFSTI: HC $3.00/MF $0.65

Preliminary experiments indicate that there is a definite dependence of superconducting transition temperature upon the degree of atomic ordering in A15-type structures. Two new superconductors were discovered in the course of the experimental work: the stoichiometric composition Cr_3Rh and the off stoichiometric compound $Cr_{72}Os_{28}$ with transition temperatures of 0.08K and 4.03K, repsectively. Author (TAB

N67-17884# Battelle Memorial Inst., Columbus, Ohio.
THEORETICAL INVESTIGATIONS OF THE PENETRATION OF KILOVOLT IONS AND ATOMS IN SOLIDS Final Report, 1 May 1962–1 May 1966
Eugene M. Baroody Wright-Patterson AFB, Ohio. ARL, Jul. 1966 50 p refs
(Contract AF 33(657)-8853)
(ARL-66-0149; AD-643834) CFSTI: HC $3.00/MF $0.65

Major sections treat two distinct problems arising in the theory of ion penetration. In the first, the Boltzmann transport equation and the method of Mellin transforms are used to calculate moments of the range distribution of particles stopped by elastic collisions in a medium of randomly located target atoms when cross sections are products of factors depending on energy and angle separately. Results are given for inverse power repulsive potentials and, with additional approximations, for Coulomb potentials with Thomas-Fermi screening. The effect of having several kinds of stopping atoms is considered and comparisons with measurements on amorphous WO3 are included. The representation of range distributions by using moments in an Edgeworth series is also treated. The second problem, the spreading of weak disturbances in crystals, has a bearing on energy loss from focused collision sequences and similar questions. Detailed results are given for the energy loss from a disturbed atom in a simple cubic lattice with central and noncentral forces between nearest neighbors. These include the calculation of additional terms in the expansion which applies at long times. Author (TAB)

N67-17826*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMOELECTRIC POWER IN SILVER–GOLD AND SILVER–GERMANIUM ALLOYS
I. Weinberg 1 Jan. 1967 15 p refs
(Contract NAS7-100)
(NASA-CR-81639; JPL-TR-32-1060) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The thermoelectric powers of dilute silver–gold and silver–germanium alloys are determined from 78 to 300°K. Nordheim–Gorter plots are carried out for these alloy systems at 273 and 295°K; and the characteristic thermopowers S_A^1 and S_B^0, attributed to solute and solvent, respectively, are determined. Calculated values of S_A^1, for both alloy systems, agree in sign and approximate numerical value with the experimental values. For Ag–Au, small or negligible Fermi surface changes are indicated up to the maximum gold concentration of 1.5 at.%. This is in agreement with recent conclusions based on polar-reflection Faraday experiments in Ag–Au. The Ag–Ge data, however, deviate from the expected linearity predicted by the Nordheim–Gorter relation at approximately 0.5 at.%. The deviation in the Ag–Ge case is attributed to Fermi surface changes as a result of alloying. A detailed comparison of the current Ag–Au data with previous results for Cu–Ag and Cu–Au is carried out by use of a Nordheim–Gorter type relation for the difference in thermopower ΔS between the pure metal and alloy. It is found that, for a given solute concentration, ΔS is greatest in Ag–Au, decreases in Cu–Au, and is still less in Cu–Ag. It is concluded that the observed ΔS differences are attributable to a possible combination of small Fermi surface changes and slight differences in electronic charge associated with the solute atoms when compared to the host atom in these alloys. Author

N67-17862# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
AMPLIFICATION AND DISPERSION OF OPTICAL PHONONS IN POLAR SEMICONDUCTORS
Peter Weissglas 15 Aug. 1965 14 p refs
(Contract AF 61(052)-888)
(SR-3; AFCRL-66-566; AD-637865) CFSTI: HC $3.00/MF $0.65

The interaction between conduction electrons and optical phonons is studied. It is shown that as soon as the electron drift velocity exceeds the phase velocity of the phonons an instability occurs which appears to be strong enough to overcome damping effects. The dielectric constant of the electrons is a function of wave number and due to this effect the group velocity of the optical phonons is greatly increased. One would therefore expect an increased thermal conductivity due to optical phonons in polar semiconductors with a high density of conduction electrons. Author (TAB)

N67-17889# Cornell Univ., Ithaca, N. Y. Materials Science Center.
ASPECTS OF HELICON PROPAGATION IN METALS
John Raymond Merrill (Ph.D. Thesis) Sep. 1966 117 p refs
(Contract AT(30-1)-2150)
(NYO-2150-19) CFSTI: HC $3.00/MF $0.65

The helicon is an electromagnetic wave which can propagate in the electron gas of a solid in the presence of a large magnetic field. This wave motion is analogous to excitations known as "whistlers" in ionospheric physics and has been studied since 1961 in both metals and semiconductors. Several experiments are discussed which concern the basic properties of the helicon wave in metals and the use of the wave to measure electronic properties of interest to solid-state physics. A brief resumé of the properties of the helicon wave is given. Mode structure for helicon standing wave resonances is then discussed with particular emphasis on experiments probing the so-called transverse modes and even modes. Size effects in d-c galvano-magnetic experiments as well as in helicon propagation are discussed. The size effects are not sufficient to explain published anomalies in Doppler-shifted cyclotron resonance studies. An attempt at the pulse propagation of helicon waves is discussed, and suggestions are made concerning possible new experiments. The ability of standing wave helicon resonances to measure the anisotropy of the magnetoresistivity and the Hall coefficient is discussed in detail, and experimental examples with aluminum and silver are used to demonstrate the merits and demerits of the method. The absolute calibration of uncorrected superconducting solenoid magnets is discussed in some experiments not directly related to the helicon. The experiments utilize nuclear magnetic resonance at low temperatures (4°K). Results on the inhomogeneity of a 50 kG superconducting magnet are included. Author (NSA)

N67-17904# Illinois Univ., Urbana. Dept. of Computer Science.
THEORY OF ELECTRON TRANSPORT PROCESSES IN TUNNEL DIODES
Michael Faiman (Ph.D. Thesis) 19 Sep. 1966 68 p refs
(Contract Nonr-1834(15))
(Rept.-214; AD-643825) CFSTI: HC $3.00/MF $0.65

A unified theory of conduction processes in tunnel diodes is presented. The use of Fermi-Dirac distributions in non-equilibrium tunneling integrals is justified. The direct tunneling mechanism is examined from two points of view and is shown to be described about equally well by either. In subsequent sections, indirect tunneling and the phenomena of excess and thermal currents are treated. Author (TAB)

N67-18018*# California Univ., Santa Barbara.
OPTICAL STUDY OF THE ELECTRONIC BAND STRUCTURE OF DIAMOND
Richard Arthur Roberts Jan. 1967 94 p refs
(Grant NsG-91-60)
(NASA-CR-81729) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Absolute normal incidence reflection measurements at both room and liquid nitrogen temperatures were taken on a polished

Type I and both cleaved and polished Type IIa diamond crystals in the range from 5.5 to 11.5 eV. A pumping system was used in the low temperature work to eliminate oil contamination of the crystal surface. Additional room temperature measurements up to 31 eV were made on the polished Type I and cleaved Type IIa crystals. The dielectric function was obtained over a broad energy range (5.5–31 eV) and structure was observed at 7.3, 7.8, 12.2 and 23 eV. Evidence that the 23 eV peak is not intrinsic to diamond is presented. New low temperature observations on the absorption threshold indicate that the previously suggested model based on a hybrid exciton is probably incorrect. It is concluded that the direct band edge is near 7.3 eV. The previously unobserved temperature dependent 7.8 eV peak can be explained as due to a change in the energy bands near the Γ point although an exciton interpretation is not excluded. Author

N67-18081*# Virginia Univ., Charlottesville. Div. of Electrical Engineering.
A STUDY OF THIN FILM VACUUM DEPOSITED JUNCTIONS Annual Status Report, 5 Dec. 1965–5 Dec. 1966
Robert L. Ramey Jan. 1967 11 p refs
(Grant NsG-340)
(NASA-CR-81734; EE-4012-107-670) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Thin polycrystalline germanium films were deposited at a mean rate of 7.5 Å /second on an amorphous substrate at 500°C and their parameters were analyzed experimentally. It was found that film dimensions and surface scattering conditions were determined through the film mobility term $1/\mu F = A \log_{10} B/a$ where A represents volt-seconds/cm^2, B = Angstrom units, and μ_F accounts for the thinness of the film. Also reported was the preparation of CdSe films by codeposition of Cd and Se from separate crucibles; studies on the electronic properties of junctions between thin films of CdSe and various metal films; construction of bolometers using thin Ag and Au films; and the modification of a chopper type field strength meter for use with semiconducting films. G.G.

N67-18094* Denver Univ., Colo. Dept. of Physics.
COMPUTER CALCULATIONS ON INTERSTITIAL GEOMETRY IN LATTICES OF HARD SPHERES, PART I Final Report
E. N. Sickafus Jan. 1967 10 p refs
(Grant NsG-648)
(NASA-CR-81750) CFSTI: $3.00 CSCL 20L

Listings of a computer program used for studying the interstitial geometry of crystalline solids, are presented. A block diagram of the program is depicted. A solution for the tetrahedral interstitial was derived on the basis of a preferentially oriented tetrahedral group; and a general solution was developed for an arbitrarily oriented group. The general solution was tested and compared with calculations of selected structures. Seitz's matrix algebra was adapted to computer format for generating unit cells of the 230 space groups. In addition, a system of computer tests was devised to enable the computer to make an analysis of the unit cell based on tetrahedral groupings of spheres. An overall program for studying the 230 space groups was assembled from the general solution, the matrix algebra, and the system of computer tests. L.S.

N67-18100*# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
AN MO THEORY OF THE CUBIC FIELD SPLITTING OF $3d^5$ ^6S IONS IN II–IV COMPOUNDS OF T_d SYMMETRY
G. H. Azarbayejani (Ph.D. Thesis) and Chihiro Kikuchi Oct. 1966 149 p refs
(Grant NsG-115-61; ORA Proj. 04381)
(NASA-CR-81736; Rept.-04381-9-T) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Molecular orbital techniques were employed to find the cubic field splitting 3a of $(3d)^5$ ^6S ions in II VI compounds of T_d symmetry. The parameter 3a is calculated by perturbation analysis, through spin-orbit interaction between the ground state t_a^3 e_a^2 $^6A_1$ and excited states $|t_a^5$ S_1 h_1 e_a^{4-p} S_2 h_2, γ S_3 h_3, S h >. Here t_a,e_a are the antibonding orbitals of the complex composed of the $(3d)^5$ ^6S ion and its four nearest ligands and p and 4-p are the hole configurations of orbitals t_a and e_a, respectively. The perturbation calculations have been carried out up to the fourth order which is the lowest order necessary for the splitting 3a to occur. Numerical results, obtained for states $|\chi S = 5/2$ h > of Fe^{3+} in the series of ZnS, ZnSe and ZnTe compounds with a reasonable set of coefficients of linear combination of atomic orbitals and an average promotion energy of 32000 cm^{-1}, indicate that the term C_4 ζ_p^4 contributes a large negative value to 3a in agreement with experimentally determined 3a of Fe^{3+} in ZnTe. Author

N67-18120*# Stanford Univ., Calif. Solid-State Electronics Labs.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, 30 Sep.–30 Dec. 1966
30 Dec. 1966 40 p ref
(Grant NsG-555)
(NASA-CR-81790) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Optical spectra of divalent ion in cadmium sulfide and gallium arsenide and nickel in gallium phosphide are discussed, as are spectra of cobalt in cadmium telluride, zinc telluride, GaAs and GaP taken at liquid helium temperatures. Crystal field theory is considered to explain the splitting of the ground state ^5E of the d^5 configuration in II-VI and III-V compounds. The fine structure that always appears in the low energy side of the spectrum reflects the fine splitting of the ^5E level. Crystal field theory permits exact values for both the crystal field strength parameter and the spin-orbit coupling constant in the crystal. Properties of rectifying junctions in GaP and GaAs xp_{1-x} are studied; and imperfections in single crystals of GaP are studied with an optical microscope, some chemical etchants, and Lang topography. Another study deals with shallow donor impurities in GaP, and several diffusions made with radiotracer sulfur 35 reveal quite small diffusion coefficients. M.W.R.

N67-18135*# California Univ., Santa Barbara. Dept. of Physics.
OPTICAL CONSTANTS OF MAGNESIUM OXIDE IN THE FAR ULTRAVIOLET
D. M. Roessler and W. C. Walker [1966] 10 p refs
(Grant NsG-91)
(NASA-CR-81792) CFSTI: HC $3.00/MF $0.65 CSCL 20L

To obtain further information on the refractive index, n, or the absorption index, k, of magnesium oxide crystals beyond the ultraviolet transmission limits, the electronic spectrum of crystalline magnesium oxide was studied. The intermediate derivation of the optical properties of magnesium oxide, from measurements of the near-normal-incidence reflectance spectrum, is reported as far as 28 eV. Experimental measurements of the reflectance are considered accurate to about 5%. R.U.

N67-18136*# California Univ., Santa Barbara. Dept. of Physics.
OPTICAL CONSTANTS OF LITHIUM FLUORIDE IN THE FAR ULTRAVIOLET
D. M. Roessler and W. C. Walker [1966] 9 p refs
(Grant NsG-91)
(NASA-CR-81793) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Optical parameters, of refractive and absorption indexes, n and k, were computed from reflectivity during the course of data analysis of lithium fluoride. Very briefly reported is the near-normal-incidence reflectance of freshly cleaved crystals of lithium fluoride, measured from the near ultraviolet to 28 eV. R.U.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-16951# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
HYDROCARBON FUELS FOR HYPERSONIC VEHICLES
Herbert R. Lander, Jr. and Alan E. Zengel *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. 1 1966 33 p refs (See N67-16941 07-34) CFSTI: HC$3.00/MF$0.65

Catalytic studies thus far have shown that the group of hydrocarbons with the greatest endothermic reactivity are the naphthenes. Laboratory investigations have indicated that the methylcyclohexane (MCH)/platinum on alumina system has a total heat sink capacity of approximately 2000 British Thermal Units (BTU)/pound of fuel at 1340°F at a volumetric flow rate of 100 cubic feet/hour of fuel/cubic foot of catalyst and at a pressure of 10 atmospheres. Author

N67-18071# Technological Lab. RVO–TNO, Rijswijk (Netherlands).
TEST PENDULUM FOR BLACK GUNPOWDER [DE ZWART-BUSKRUITSLINGER]
26 Nov. 1965 24 p refs In DUTCH
(TDCK-46451) CFSTI: HC$3.00/MF$0.65

Described in detail is the pendulum device that is used in evaluating combustion properties for the purpose of standardizing Dutch black gunpowder. The device consists of the pendulum, a frame, a suspension bar, the powder chamber with lock, the registration apparatus, and the electric circuitry. The dimensions of the device, operation, evaluation of the resulting data, reproducibility of measurements, and results of test are given and discussed. Photographs and mechanical drawings are included. Transl. by K.W.

N67-18073# Technological Lab. RVO–TNO, Rijswijk (Netherlands).
CHARACTERIZATION OF DUTCH BLACK GUNPOWDER [KARAKTERISERINGSEISEN VAN NEDERLANDS ZWART BUSKRUIT]
15 Sep. 1966 17 p refs In DUTCH
(TDCK-46449) CFSTI: HC$3.00/MF$0.65

Tests and analyses were performed to establish military specifications for Dutch black gunpowder. Stressed in the present report are combustion characteristics and chemical composition. Briefly described is the evaluation of grain size, appearance of powder, cohesive strength of the grain, hygroscopic properties, and weight measurements. Included are mechanical drawings of a pendulum for testing combustion properties, a test mortar, and a device for evaluating cohesive strength. Transl. by K.W.

N67-18180 Technological Lab. RVO–TNO, Rijswijk (Netherlands).
CONSIDERATIONS FOR ESTABLISHING SPECIFICATIONS FOR DUTCH BLACK GUNPOWDER [ARGUMENTATIE KARAKTERISERINGSEISEN NEDERLANDS ZWART-BUSKRUIT]
15 Sep. 1966 25 p In DUTCH
(TDCK-46450) CFSTI: $3.00

Tests were conducted to determine the characteristics of black gunpowder for the purpose of writing military specifications. Evaluated were composition, grain size, combustion properties, cohesive strength, weight and volume measurements, and hygroscopic properties. Methods and apparatus for performing sieve analyses are described in detail. Transl. by K.W.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-17390*# National Aeronautics and Space Administration, Washington, D. C.
AIR BREATHING PROPULSION IN AEROSPACE TRANSPORT [PROPULSEUR ATMOSPHERIQUE POUR PREMIER ETAGE DE TRANSPORTEUR SPATIAL]
Jacques Dupin Jan. 1967 16 p Transl. into ENGLISH of Intern. Council of the Aeron. Sci. Rept. No. ICAS-66-28 Presented at Roy. Aeron. Soc. Centenary Congr., London, 12–16 Sep. 1966
(NASA-TT-F-10697) CFSTI: HC$3.00/MF$0.65 CSCL 21A

The French turbofan-ramjet engine with lox injection at the end of the climb phase, to be used as the first stage of a space transport or a launch vehicle, is described in some detail, with sketches of the composite engine and performance diagrams at various Mach numbers. Advantages of airbreathers over conventional ballistic launch vehicles are given, including low specific fuel consumption on return to subsonic flight and in cruising, adaptability to variations in Mach by use of either air bypass, reduction in engine weight by use of liquid oxygen for thrust augmentation, etc. Air rates of flow superior to the American Mach 3 SST or the B70 are expected by using a maximum air-inlet cross section adapted to Mach 3.7–4. Structural use of refractory metal sandwich composites, including Rene 41, molybdenum, niobium, and tantalum, for temperatures to 1600°C is discussed briefly. Author

N67-17399*# National Aeronautics and Space Administration, Washington, D. C.
STUDY AND FLIGHT TESTS OF A MACH 5 EXPERIMENTAL RAMJET [ETUDE ET ESSAIS EN VOL D'UN STATOREACTEUR EXPERIMENTAL A MACH 5]
Roger Marguet Nov. 1966 39 p refs Transl. into ENGLISH of Office Natl. d'Etudes et de Rech. Aerospatiales Rept. TN-94, 1966
(NASA-TT-F-10319) CFSTI: HC$3.00/MF$0.65 CSCL 21A

Studies and research on high speed atmospheric propulsion have led O.N.E.R.A. to experiment in flight with ten ramjet missiles. This operation received the code name of "STATALTEX." Four missiles reached a flight speed of nearly 4,600 feet per second, i.e., about Mach 5, between the altitudes of 40,000 to 115,000 feet. The information obtained in the course of this study is described and theoretical predictions and experimental results are compared. The knowledge acquired permitted us to obtain useful data applicable to an eventual atmospheric booster able to reach Mach 5. Author

N67-17503*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR PERFORMANCE EVALUATION OF A SCALE-MODEL FUEL PUMP TURBINE FOR THE AM-1 HYDROGEN-OXYGEN ROCKET ENGINE
Roy G. Stabe, John F. Kline, and Edward H. Gibbs Washington, NASA, Feb. 1967 36 p refs
(NASA-TN-D-3819) CFSTI: HC$3.00/MF$0.65 CSCL 21H

The aerodynamic performance of a 0.646-scale-model fuel turbopump drive turbine for the M-1 rocket engine was determined experimentally. The working fluid used in the investigation of the two-stage velocity-compounded turbine was dry air at inlet total

conditions of 25 psia and 600°R. The turbine inlet manifold assembly was first tested as a separate unit. Two-stage and first-stage turbine configurations, including the inlet manifold, were then tested over a range of speeds and pressure ratios. The convergent-divergent nozzle choked at a pressure ratio of 1.5, resulting in constant equivalent weight flow over the range of speeds and pressure ratios investigated. The actual equivalent weight flow was 2.88 lbs/sec, which was 1.5% greater than the design value of 2.837 lbs/sec. Manifold static pressure measurements and circumferential surveys of nozzle exit total pressure indicated a considerable circumferential variation in inlet manifold assembly flow conditions. These variations were largely confined to approximately one-third of the manifold circumference centered about the inlet feedpipe. The loss in total pressure between the feedpipe and nozzle inlet was about 5% of inlet total pressure or 1.2 inlet velocity heads. At design equivalent speed and pressure ratio, the two-stage turbine static efficiency was 0.65 compared to the design value of 0.622. The equivalent specific work was 29.7 Btu/lb, or 4.5% greater than design. The first stage produced 71.7% of the total work at a static efficiency of 0.51. The design values were 72.3% and 0.490, respectively. The total efficiency of the first stage was 0.64 compared to the design value of 0.599. Author

N67-17504*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL INVESTIGATION OF ACOUSTIC LINERS TO SUPPRESS SCREECH IN HYDROGEN-OXYGEN ROCKETS

John P. Wanhainen, Harry E. Bloomer, David W. Vincent, and Jerome K. Curley Washington, NASA, Feb. 1967 44 p refs
(NASA-TN-D-3822) CFSTI: HC$3.00/MF$0.65 CSCL 21H

An investigation of suppression of high frequency combustion instability using Helmholtz type acoustic damping devices was conducted in a hydrogen-oxygen rocket of nominally 20,000-pound thrust size. Acoustic linear design variables investigated include the number and the diameter of the apertures, the thickness of the liner, the length of the liner, and the gap height behind the liner. The tests were conducted at a chamber pressure (nominal) of 300 pounds per square inch absolute and a range of oxidant-fuel ratios from 4 to 6. Hydrogen injection temperature was used to rate the stability of the various liners. The liner with the lowest self-triggering temperature was considered to be the most stable design. High frequency combustion instability in hydrogen-oxygen engines of the size investigated can be suppressed using a properly designed array of Helmholtz resonators. The hydrogen temperature at which screech occurred could be reduced from 112° to less than 60°R (minimum available) by incorporating an acoustic liner with a calculated absorption coefficient of 0.25 or greater. Analytical predictions based on acoustic theory were in limited agreement with experimental results providing a flow past the apertures of 0.2 free stream velocity was included in the calculation of absorption coefficient. Liner cavity gas temperature varied from 600° to 1000°R during stable combustion depending on the number of apertures and increased to 2000°R during screeching combustion. A 17% partial length liner positioned at the injector end of the thrust chamber had the same stability characteristics as the full length liner. Author

N67-17508* United Aircraft Corp., East Hartford, Conn.

THEORETICAL PERFORMANCE OF ROCKET ENGINES USING GASEOUS HYDROGEN IN THE IDEAL STATE AT STAGNATION TEMPERATURES UP TO 200,000 R

R. Roback Washington, NASA, Feb. 1967 220 p refs
(Contract NASw-847)
(NASA-CR-696) CFSTI: HC$3.00/MF$0.65 CSCL 21H

Theoretical performance parameters for rocket engines utilizing normal gaseous hydrogen in the ideal state were calculated using two different assumptions: first, that the chemical composition remained in equilibrium during the isentropic expansion through the engine exhaust nozzle; and, second, that the chemical composition remained fixed (frozen) during the expansion. Data are presented for stagnation temperatures ranging from 5000 to 200,000 R, stagnation pressures ranging from 1 to 2000 atm, and ratios of exhaust pressure to stagnation pressure ranging from 1 to 10^{-7}. The following performance parameters were calculated as a function of the ratio of nozzle exhaust pressure to stagnation pressure: temperature, enthalpy, entropy, molecular weight, density, velocity, Mach number, specific impulse, and ratio of nozzle-exit area to throat area. Also calculated were several other properties of the gaseous mixture at the throat of the nozzle, such as the weight flow per unit area and a throat flow parameter defined as the product of the weight flow per unit area at the throat and the square root of the stagnation temperature divided by the stagnation pressure, $(W\sqrt{T_T}/A^* P_T)$. Author

N67-17512*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY TESTS OF INSULATED ACCELERATOR GRID FOR ELECTRON-BOMBARDMENT THRUSTOR

Paul M. Margosian Washington, NASA, Feb. 1967 14 p refs
(NASA-TM-X-1342) CFSTI: HC$3.00/MF$0.65 CSCL 21C

An electron-bombardment ion thrustor was operated with a single, insulated accelerator grid. Grids were made of drilled metal plates coated with a thin layer of ceramic, drilled ceramic plates coated with a thin layer of metal, and match-drilled plates of ceramic and metal bolted together. The insulating material separated the plasma in the ion chamber from the negatively biased accelerator grid, and thus eliminated the positively biased screen grid normally used for this purpose. Operation was possible at net accelerating voltages of 400 to 4000 volts. The ion-chamber power required per beam ion was reduced by a factor of two or more from that obtained with conventional grids. Author

N67-17628*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF TWO SUBLIMING-SOLID-PROPELLANT THRUSTOR SYSTEMS FOR ATTITUDE CONTROL OF SPACECRAFT

Frank D. Berkopec Washington, NASA, Feb. 1967 17 p refs
(NASA-TN-D-3841) CFSTI: HC$3.00/MF$0.65 CSCL 21H

A 10^{-2}-pound-force thrust system utilizing ammonium hydrosulfide (NH_4HS) as the propellant, and a 2×10^{-4}-pound-force thrust system utilizing ammonium carbamate ($NH_4CO_2NH_2$) as the propellant were investigated. The former subliming solid propellant thrustor system demonstrated a specific impulse of 65 pounds force per pound mass per second, 74% of isentropic, during steady state operation. Pulsed mode operation, with command pulse width from 2.0 down to 0.020 second, showed the impulse bit to be repeatable and predictable. The 2×10^{-4}-pound-force thrust system demonstrated a specific impulse of 48.1 pounds force per pound mass per second, 61% of isentropic, during steady state operation. The steady state performance of both systems was comparable to that of conventional cold gas systems. The sensitivity of the propellant vapor pressure (and, therefore, thrust level) to temperature was approximately 5% per °R for both systems. This operating characteristic must be carefully controlled to facilitate attitude control. Author

N67-17638*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MANUFACTURING AND TEST PROCEDURES FOR AEROBEE 350 BURST DIAPHRAGMS

J. A. Munford and W. J. Hungerford Oct. 1966 33 p
(NASA-TM-X-55854; X-284-479) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A manufacturing process developed for producing high quality fuel and oxidizer burst diaphragms for the Aerobee 350 propellant start valves is described. It is shown that extremely close control of material and processing variables is necessary to attain the high degree of repeatability of burst pressures required. Author

N67-17650# AiResearch Mfg. Co., Phoenix, Ariz.
ALTITUDE TEST, ADVANCED FUEL CONTROL AND COMBUSTION SYSTEM FOR TURBOPROP ENGINES
G. G. Johnson 23 Aug. 1966 302 p refs
(Contract NOw-63-0790-ci)
(GT-7762-R; AD-642042) CFSTI: HC $3.00/MF $0.65

The report describes simulated altitude flight testing of an advanced fuel control and combustion system. The contract provides for the development of a fuel and control system that will enable a turboprop engine to operate on a wide variety of contaminated fuels. The engine testing was conducted to fulfill the functional verification requirement of the contract, and verified the capabilities of this advanced system to start and operate under simulated flight conditions using a variety of fuels. Starting tests were accomplished with specified fuels at several simulated flight speeds at altitudes of sea level, 5,000, 10,000 and 25,000 feet. Steady-state engine operational tests were also accomplished at several simulated flight speeds at altitudes of sea level, 10,000 and 25,000 feet. Author (TAB)

N67-17771*# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
TRANSIENT AND STEADY PERFORMANCE OF AN ION ROCKET THRUST AUGMENTOR Summary Report
Dec. 1964 37 p refs
(Grant NsG-570)
(NASA-CR-70561) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Research directed toward developing a technique for overcoming the space charge limiting condition of an ion rocket by introducing electrons into the accelerator system. An experimental facility was put into operation, as well as a cesium contact ion rocket with provisions for the injection of electrons. Work also began on a theoretical model to explain the acceleration of ions due to the counter flow of electrons, and on evaluation of secondary electron emission from a cesium coated ionizer. Three instruments were developed to analyze the ion beam: a hot-wire calorimeter, an ion energy analyzer, and a floating emission probe. S.P.

N67-17780*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPLICATION OF AIRBREATHING PROPULSION TO REUSABLE LAUNCH VEHICLES
G. R. Woodcock and D. D. Thompson [1965] 22 p ref
(NASA-TM-X-57064) CFSTI: HC $3.00/MF $0.65 CSCL 21A

Mission and performance requirements are briefly reviewed to provide proper context for information given. The principal mission considered is logistics operations to Earth orbit. Second stages are assumed to be reusable, cryogenic, rocket propelled, lifting bodies or wing-bodies. Attention is concentrated on the propulsion options for the reusable first stage. Results of semi-quantitative comparison studies using a matrix of criteria are given. It is shown that under certain combinations of assumptions and criteria, rocket propelled first stages may be preferable to airbreathing first stages. Frequently a mixture of rocket and airbreathing propulsion will appear preferable. The influence of mission requirements is illustrated. Author

N67-17856*# Bell Aerosystems Co., Buffalo, N. Y.
NOZZLE PERFORMANCE EVALUATION PROGRAM Final Report
24 Feb. 1964 112 p
(Contract NAS9-1467)
(NASA-CR-56428; Rept.-8289-933002) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Sea-level and altitude tests were conducted to evaluate the performance of four nozzles: three with exit area ratios (ϵ) of 40 and one with an area ratio of 60. The ϵ=40 nozzles were a 15° conical, an 80% bell (Agena-type), and a Rao optimum contour. The ϵ=60 nozzle was also a 15° conical type. Testing was conducted at a nominal thrust level and chamber pressure of 1000 pounds and 100 psia, respectively, over a nominal reactant ratio range of 1.60 to 2.00. The propellants were N_2O_4 and a 50/50 blend of N_2H_4-UDMH. The sea level injector testing was conducted to evaluate injector performance and to determine hardware durability. The altitude testing was to determine the performance at nominal test conditions. K.W.

N67-17866*# Thompson Ramo Wooldridge, Inc., Inglewood, Calif. Reaction Control Systems.
ALL METAL VOLATILE LIQUID POSITIVE EXPULSION SYSTEM Final Summary Report, 28 Dec. 1962–15 Jun. 1964
Saverio F. Giffoni 15 Jun. 1964 165 p refs
(Contract NAS9-1004; TRW Proj. 512-009935-78)
(NASA-CR-65548; ER-5980) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Results of an analytical study and experimental demonstration of the basic concepts of an all-metal, volatile liquid, positive expulsion system are presented. The basic pressurization system envisioned includes an all-metal positive-expulsion propellant tank with an integral pressurization system that utilizes a two-phase volatile liquid as the pressurant. The volatile liquid pressurization system provides a propellant tank and pressurization system which is integral and sealed within a common pressure vessel. The pressurant tank, pressure regulator, check valves, relief valves, and other associated plumbing normally found in a propellant feed system are eliminated in this system. The major problem encountered on the volatile liquid program was the fabrication of the thin (1 to 3 mils) hemispherical metallic expulsion diaphragms. Tests definitely demonstrated the practicality of a two-phase volatile liquid system for advanced reaction control systems. S.P.

N67-17935# Library of Congress, Washington, D. C. Aerospace Technology Div.
PROPULSION TECHNOLOGY Monthly Survey No. 1
Oct. 1966 57 p refs
(ATD-66-121)

This monthly survey is based on current open sources of the Eurasian Communist countries. It is the first in a series of monthly reports and it deals with air breathing and rocket propulsion technology and the related nonchemical aspects of combustion. The report is divided into three sections. Section I (Review of the literature of the Warsaw-Pact countries) covers three types of information: Air breathing propulsion (1. Rotating engines–15 articles; 2. Non-rotating engines–3 articles); rocket propulsion (1. Liquid rocket propulsion–9 articles); combustion engineering (1. Subsonic combustion of fuel and air–8 articles; 2. Supersonic combustion of fuel and air–1 article; 3. Combustion of liquid rocket propellants–4 articles; 4. Combustion of solid rocket propellants–5 articles). Section II (Review of Communist Chinese literature) covers only air breathing propulsion with three articles and a monograph review. Section III (Appendix) lists 27 available translations and 20 source documents. Author

N67-17970*# Martin Co., Denver, Colo.
STERILIZABLE LIQUID PROPULSION SYSTEM Quarterly Progress Report, 5 Oct.–30 Dec. 1966

H. F. Brady and C. Caudill Jan. 1967 62 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951709)
(NASA-CR-81642; QPR-1; MCR-67-15, Issue 1) CFSTI: HC $3.00/MF $0.65 CSCL 21H

System design and materials investigation progress is reported from a project involving the exposure of an assembled and fueled bipropellant liquid propulsion system to ethylene oxide (ETO) and heat sterilization environments. As a result of the materials research, it was concluded that titanium alloy 6Al-4V and aluminum alloys 6061-T6, 2014-T6, and 2219-T8 are the most promising materials for constructing either oxidizer or fuel propellant tanks and associated hardware. Study activities in the areas of propellant and engine selection, component design and analysis, and test plan development are also discussed. A.G.O.

N67-18033* Hughes Research Labs., Malibu, Calif.
HIGH-TEMPERATURE LIQUID-MERCURY CATHODES FOR ION THRUSTORS Quarterly Report, 1 Sep.–30 Nov. 1966
W. O. Eckhardt, G. Hagen, J. A. Snyder, and R. C. Knechtli 30 Nov. 1966 13 p refs
(Contract NASw-1404)
(NASA-CR-81690; QR-2) CFSTI: HC $3.00 CSCL 21C

Stable, long run operation of high temperature cathodes as well as excellent thrustor performance with high temperature cathodes has been demonstrated. The most important achievement was the demonstration of thrustor performance with high temperature cathodes closely approximating the best obtained with low temperature cathodes: 87% mass utilization with 400 eV/ion at 250°C cathode temperature, and 84% mass utilization with 443 eV/ion at 300°C cathode temperature. Author

N67-18041*# Hughes Aircraft Co., Culver City, Calif. Space Systems Div.
SOLAR POWERED ELECTRIC PROPULSION Program Summary Report
Dec. 1966 204 p refs Prepared for JPL
(Contract JPL-951144)
(NASA-CR-81703; SSD-60374R) CFSTI: HC $3.00/MF $0.65 CSCL 21C

The feasibility of a solar-powered electric-propulsion spacecraft capable of performing deep space missions was studied by low thrust mission analysis for a three dimensional trajectory program. Considered were perturbations due to Earth, Mars, and Jupiter, as well as effects of solar pressure acting on the solar panel. It was concluded that total solar-powered electric-propulsion systems specific weights of 50 pounds per kilowatt or less were feasible and more advantageous than all-chemical propulsion systems. The following three detailed electric propulsion spacecraft designs evolved as most adaptable to different planetary missions: one spacecraft compatible with the Titan III M launch vehicle and one compatible with the Saturn IB/Centaur launch vehicle for Mars orbiter/lander missions; and one spacecraft compatible with the SLV-3C/Centaur launch vehicle to accomplish Jupiter flyby and out-of-the-ecliptic missions. G.G.

N67-18098* Colorado State Univ., Fort Collins. Coll. of Engineering.
ELECTRIC PROPULSION FOR LUNAR MISSIONS
Timothy D. Fehr (M.S. Thesis) 22 Nov. 1966 173 p refs
(Grant NGR-06-002-032)
(NASA-CR-81742; MER66-67WRM-5; Rept.-2) CFSTI: $3.00 CSCL 21C

A number of mission profiles involving combinations of high-thrust and low-thrust propulsion systems are explored for their effect on payload capacity. Round trip performance for various mission profiles are investigated in terms of payload to the lunar surface and payload returned to earth orbit. The electric propulsion phases of the mission profiles are evaluated for constant thrust-to-mass ratio utilizing a modified Sauer–Melbourne correlation, and for constant thrust utilizing the Zola characteristic length method. For mission profiles with electric propulsion starting from a low parking orbit at earth, electric spacecraft would be superior to all-chemical propulsion if the electric propulsion system specific mass is less than 20 Kg/Kwj for one-way trips and less than 25 Kg/Kwj for multiple round trips. Author

N67-18192* General Precision, Inc., Sunnyvale, Calif. Link Ordnance Div.
IMPROVEMENT OF IGNITION SYSTEM FOR SIMULTANEOUS IGNITION OF RETRO AND ULLAGE MOTORS ON SATURN V
D. E. Davenport, L. D. Pitts, and J. N. Gardner 30 Jul. 1965 111 p refs
(Contract NAS8-11472)
(NASA-CR-68171; L/S-U-819) CFSTI: HC $3.00 CSCL 21B

The investigation of the mechanical techniques for causing transition from detonation to deflagration within less than one inch with minimum residual shock, the chemical techniques for causing transition under the same conditions, and the methods of evaluating the effectiveness of these techniques is summarized. Among the conclusions was that detonation to deflagration transitions may be obtained in distances well under one inch with a wide variety of deflagration mixes. When direct coupling technique is used the transition is made more reliably and in a shorter distance if the detonation velocity and resulting shock pressure is low and the density of the deflagration mix is of the order of 50% to 75% of crystal density. Ignition of PETN through a metal barrier can provide transition coupling for an ignition mix by providing a 5 to 10 mm zone in which the detonation velocity provides a low-shock flame output which is desirable for ignition of deflagrating mixes. PETN does not appear to be the best explosive to use with the metal barrier technique since the range of thicknesses of barrier to provide a desirable long buildup zone is relatively small. E.E.B.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-17240# Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.
MEASUREMENTS OF THE CENTER-LIMB VARIATIONS ON THE H-LINES AND K-LINES OF CaII IN UNDISTURBED AND ACTIVE REGIONS ON THE SUN
Oddbjoern Engvold 1966 13 p refs *Its* Inst. of Theoret. Astrophys. Rept. No. 17
(Contract AF 61(052)-743)
(SR-12; AFCRL-66-712; AD-642575) CFSTI: HC $3.00/MF $0.65

The center-limb variation of delta(lambda-2), defined as half the distance between the emission peaks in the doubly reversed H- and K- lines was investigated. The observational material consists of spectra obtained at the Solar Observatory, Harestua, during the period February 1, 1964 to January 1, 1966. In undisturbed regions the center-limb variation may be represented by a well defined smooth curve. This is not the case in active regions although there is a tendency for the delta(lambda-2) to increase towards the limb. The difference between the measurements in the H- and K- lines is probably due to a systematic error in the observed delta(lambda-2) in the H-line. Author (TAB)

N67-17803# European Space Research Lab., Noordwijk (Netherlands).
DESCRIPTION OF EXPERIMENTS R-4 AND R-58, SARDINIA, DECEMBER 1965: SOLAR SOFT X-RAY PHOTOMETRY AND SPECTROMETRY
R. Jaeschke Paris, ESRO, May 1966 18 p refs
(ESRO-SN-55 (ESLAB)) CFSTI: HC $3.00/MF $0.65

The two scientific experiments carried in a Centaur rocket launched from Sardinia in Decmeber 1965 are described. They were designed to measure the intensity and spectral distribution of the soft X-ray flux of the sun. The first experiment comprised two proportional gas counters, whose outputs, after suitable pulse-height discrimination, indicated the respective intensities of soft X-rays in three distinct wavebands, i.e. 60–44 Å, 24–23 Å and below 20 Å (R-4, for the Space Res. Lab., Utrecht); the second experiment was a measurement of the intensity in the regions 44–60 Å and 44–70 Å by means of two sealed gas counters having slightly different window thicknesses (R-58, for Dept. of Physics, Leicester Univ.). The actual launching was only partly successful, experiment R-58 having been destroyed by excessive heating and experiment R-4 having suffered a temporary power failure. Author (ESRO)

N67-17818# United Kingdom Atomic Energy Authority, Culham (England).
SOLAR XUV OBSERVATIONS FROM STABILISED SKYLARK ROCKETS
R. Wilson Paris, ESRO, Apr. 1966 14 p refs Lecture Given at ESRO Summer School, Alpbach, Austria, Aug. 1965
(ESRO-SM-67) CFSTI: HC $3.00/MF $0.65

The attitude control unit developed for the Skylark sounding rocket is described: this unit points the whole rocket head at the sun with lateral errors of a few minutes of arc and roll error of a few degrees. A fine-guidance system was built at Culham Laboratory which, when mounted on the stabilized Skylark head, allows spectrograms and images to be taken with lateral deviations of not more than a few seconds of arc. The results of three rocket flights carried out by the author's group in 1964 and 1965 are discussed. Author (ESRO)

N67-17875*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIMULTANEOUS TRAPPED ELECTRON AND MAGNETIC TAIL FIELD OBSERVATIONS
Donald J. Williams and Norman F. Ness Jun. 1966 43 p refs Submitted for Publication
(Contract NOw-62-0604-c)
(NASA-TM-X-55581; X-611-66-264) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Using data from the polar orbiting satellite 1963 38C, the behavior of the high latitude energetic (≥280 keV) electron trapping boundary, Λ_o at 1100 km is presented for the period March 15 through June 3, 1964. A sudden collapse of Λ_c to lower latitudes during the onset of magnetic storms, as indicated by K_p and D_{st}, is found to be a characteristic feature of the low altitude trapped electron population. The NASA IMP-1 satellite sampled field characteristics in the geomagnetic tail. Correlated observations of the simultaneously observed behavior during magnetic disturbences of the 1100 km trapped electron population and of the field strength in the tail are presented. In three cases there is agreement and in one case disagreement with the latitude decreases which are predicted with an extended geomagnetic tail configuration. These results show the influence exerted by the geomagnetic tail field in governing the quiet time trapped particle distribution and the behavior of the trapped particle population during magnetic storms. Author

N67-18016*# Oak Ridge National Lab., Tenn.
CALCULATIONS OF THE RADIATION HAZARD DUE TO EXPOSURE OF SUPERSONIC AIRCRAFT TO SOLAR FLARE PROTONS
M. Leimdorfer, R. G. Alsmiller, Jr., and R. T. Boughner 7 Dec. 1966 73 p refs Submitted for Publication
(NASA Order R-104(1))
(NASA-CR-81727; ORNL-TM-1594) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Monte Carlo transport calculations were carried out to estimate the dose which travelers in supersonic aircraft will receive from a typical spectrum of solar flare protons. This dose, from both primary protons and secondary particles, as a function of depth in a tissue slab placed at various depths in the atmosphere was obtained. The incident spectrum is broken into eight energy regions and the dose from the incident protons in each of these regions is presented. Author

N67-18078*# Kitt Peak National Observatory, Tucson, Ariz.
INTERPLANETARY GAS. XIII: GROSS PLASMA VELOCITIES FROM THE ORIENTATIONS OF IONIC COMET TAILS
John C. Brandt New York, NASA Goddard Inst. for Space Studies, 10 Jun. 1966 60 p refs Submitted for Publication
(Grants NsG-243-62; Nonr(G)-00051-62; Nonr(G)-00036-63)
(NASA-CR-81608) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Results are presented concerning the velocity of the solar wind plasma as deduced from observations of Type I (ion) tails contained in a comet catalog. Following are some of the major conclusions of the study. The solar wind has a fairly sharp velocity minimum at 150 ± 50 km/sec. Solar wind velocity is correlated with geomagnetic activity in a manner which confirms the relationship found from the Mariner II data and from travel times for geomagnetic storms. Evidence is found for a mean tangential component of the solar wind velocity near the Earth of ≈10 km/sec directed in the sense of the solar rotation. The value of the tangential velocity is apparently lower for quiet conditions and higher for disturbed conditions in the interplanetary medium. S.P.

N67-18141*# California Univ., Los Angeles.
SPACE TECHNOLOGY. VOLUME VI: SPACE SCIENCES
T. A. Farley Washington, NASA, 1966 90 p refs
(NASA-SP-114) GPO: HC $0.35; CFSTI: MF $0.65 CSCL 20H

Based on the NASA program to interest undergraduate students in the developing technology created by space exploration, expanded lecture notes on various aspects of space sciences are presented. The geomagnetic field configurations close to the earth and at a distance, emphasizing the magnetopause, are discussed. The Van Allan radiation belt is described, and details are given on its charged particle motion, trapped proton distribution and energy spectra, and trapped particle sinks and sources. Interplanetary medium and magnetic field, and the solar wind are mentioned as an introduction to the problem of the complex interaction between the solar wind and the earth's magnetosphere. The composition and origin of galactic cosmic rays are covered, and the bombardment of the earth by their energetic particles are covered. Comet structure, composition and origin are also described. Instruments for measuring the quantities are mentioned. N.E.N.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-18797*# Harvard Univ., Cambridge, Mass. Cruft Lab.
NONLINEAR FEEDBACK SOLUTION FOR MINIMUM-TIME INJECTION INTO CIRCULAR ORBIT WITH CONSTANT THRUST ACCELERATION MAGNITUDE

David H. Winfield and Arthur E. Bryson, Jr. Jul. 1966 25 p refs
(Contract Nonr-1866(16))
(NASA-CR-81474; TR-507; AD-641404) CFSTI: HC $3.00/MF $0.65

The instantaneous thrust-direction for a rocket vehicle to perform a minimum-time injection into a circular orbit of prescribed radius is determined as a function of instantaneous distance, and radial and tangential velocity relative to the attracting center. A nonlinear feedback control law for the instantaneous thrust-direction is derived which is based on the approximation that the gravity vector and the vehicle thrust acceleration magnitude during the maneuver are to be constant at values intermediate between their present and expected terminal values. The control law is shown to depend only on two dimensionless functions of the three relevant state variables, so that the solution is, in effect, expressed in a reduced state space of two dimensions. The optimal thrust-direction is defined analytically and graphically as a function on the reduced state space. The open-loop solution to the minimum-time transfer problem is the well-known linear tangent law. The new contributions are (1) showing that the solution depends on only two dimensionless functions of state and (2) putting the solution in the form of a feedback law which depends on these two functions. For a maneuver spanning a considerable arc around the attracting center (up to about 40 degrees), the solution may be used directly as a suboptimal control or to give starting values for an iterative solution of true inverse-square gravity problem. Author (TAB)

N67-16798# Aerospace Corp., El Segundo, Calif.
DERIVATION OF LINEAR-TANGENT STEERING LAWS
Frank M. Perkins Nov. 1966 22 p refs
(Contract AF 04(695)-1001)
(TR-1001(9990)-1; SSD-TR-66-211; AD-643209) CFSTI: HC $3.00/MF $0.65

The derivation of the several forms of the linear-tangent steering program is presented. The mathematical form of these equations is shown to be totally independent of the variation of thrust acceleration with time. Insofar as position and velocity changes caused by thrust only are concerned, the linear-tangent law is the precise mathematical optimum. Its utility and advantages are explained, as well as its limitations. The derivation of the thrust-direction steering law is given, but guidance equations are not. Author (TAB)

N67-16801*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEMS IN ASTROPHYSICS. INVESTIGATION OF THE ATMOSPHERES OF VENUS AND MARS
I. K. Koval', ed. Jan. 1967 169 p refs Transl. into ENGLISH of the Book "Voprosy Astrofiziki. Issledovaniye Atmosfer Venery i Marsa" Kiev, Izd. Naukova Dumka, 1965 Papers Presented at Conf. of the Working Group on Invest. of Venus and Mars, Kiev, Jun. 1964
(NASA-TT-F-394) CFSTI: HC $3.00/MF $0.65 CSCL 03B

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13. BRIEF ANALYSIS OF A PHOTOMETRIC STUDY OF BRIGHTNESS DISTRIBUTION ACROSS THE MARTIAN DISK I. K. Koval' p 81–84 refs (See N67-16814 07-30)

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15. USE OF INDICATOMETRY FOR VERIFYING THE HYPOTHESIS OF A LIMONITE SURFACE COVER ON MARS T. D. Bessonova p 91–94 refs (See N67-16816 07-30)

16. POLARIZATION STUDIES OF RADIO EMISSION FROM THE UPPER LAYER AND SURFACE COVERING OF THE PLANETS A. Ye. Basharinov, M. A. Kolosov, and A. A. Kurskaya p 95–96 refs (See N67-16817 07-30)

17. POLYCHROMATIC POLARIMETRY OF LIGHT IN THE TWILIGHT AND DAYTIME SKY AT THE ZENITH V. V. Avramchuk p 97–104 refs (See N67-16818 07-13)

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N67-16802*# National Aeronautics and Space Administration, Washington, D. C.
SPECTROSCOPIC INVESTIGATION OF THE COMPOSITION OF THE ATMOSPHERE OF VENUS
V. K. Prokof'yev *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 1–5 (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Basic components of the Venutian atmosphere, as determined by spectroscopic studies, are discussed. The hypothesis that nitrogen is the main atmospheric component is considered fairly well ascertained; and attention is given to the carbon dioxide, oxygen, water vapor, and other gaseous components. Various investigations are mentioned, including the interpretation of a banded structure as a formaldehyde emission. It is acknowledged that the spectrum of Venus is not an exact duplicate of the solar spectrum, and that there are data to indicate that absorption in carbon dioxide bands undergoes changes. M.W.R.

N67-16803*# National Aeronautics and Space Administration, Washington, D.C.

NOCTURNAL AIRGLLOW OF VENUS

N. A. Kozyrev *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 6 (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Spectral observations indicate that the Venus night airglow is composed of both luminescence from the lower atmospheric layers that is uniformly distributed over the dark side, as well as ionospheric luminescence that presents a narrow ring at the edge of the planetary disk. The luminescence from the lower atmospheric layers, the more stable of the two, has the spectrum of formaldehyde and is probably the result of hydrocarbon oxidation in the interior or on the surface of Venus. Ionospheric luminescence is subject to extreme changes, and there appears to be no relationship between such luminescence and solar activity. Emissions from this luminescence have been identified by various authors as oxygen, nitrogen, or carbon dioxide under the influence of high energy protons. M.W.R.

N67-16804*# National Aeronautics and Space Administration, Washington, D. C.

THE IONOSPHERIC HYPOTHESIS OF RADIO EMISSION FROM VENUS

A. D. Danilov and S. P. Yatsenko *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 7–12 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

The hypothesis proposed by Strelkov that the high temperatures of centimeter radio waves emitted from Venus is explained by radioactive heating of the planetary surface is discussed. The hypothesis is weakened by observations that indicate Venus has a thick ionosphere. Detailed analysis shows that the ionospheric model may be used as a basis for a complete explanation of the spectrum of brightness temperatures observed in the radio emission from Venus, although a much stronger energy source would be needed than that provided by the Earth's ionosphere. Available data show a possible correlation between solar activity and the brightness temperatures of centimeter radio emission from Venus. A positive confirmation of this correlation would be an important factor in explaining the mechanism responsible for this radio emission. Author

N67-16805*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF VENUS CLOUD COVER ON RADIO EMISSION OF THE PLANET IN THE CENTIMETER AND MILLIMETER BANDS

G. M. Strelkov *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 13–37 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

An atmospheric model with structural parameters determined by astronomical observations is used to explain the high effective temperature of radiation emission from Venus in the centimeter band. It is assumed that the cloud cover of Venus has a 3 km layer of water droplets under an 8 km layer of ice crystals; and spectral characteristics of the brightness temperature for 0.3 to 22 cm emissions were calculated for surface pressures of 5 and 10 atm. Comparison of these characteristics with measured data at various wavelengths indicates that the planetary cloud cover contains neither water nor solid nonconductive powders. Emission from the heated interior is considered as an explanation for the high effective temperature of radio emission from Venus in the centimeter range; with the depths of these layers dependent upon optical thickness of the rocks making up the planetary crust. High temperature gradients in the subsurface layers of the soil are not considered to be involved. M.W.R.

N67-16806*# National Aeronautics and Space Administration, Washington, D. C.

RESULTS FROM A PRELIMINARY ANALYSIS OF SOME SPECTROGRAMS OF VENUS TAKEN IN APRIL 1964

V. V. Avramchuk and I. K. Koval' *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 38–42 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

A spectrogram of Venus taken on April 21, 1964, reveals a bright detail with a diameter of approximately 4 in; with the spectrograph slit oriented along the line through the horns of the crescent close to the middle zone of the terminator. This spot is well defined in the ultraviolet region, gradually fades toward the long wave end of the spectrum, and vanishes at M=μ. Another spectrogram taken April 27, with slit orientation along the intensity equator was analyzed to determine the energy range in the 370 to 500 M=μ range. A considerable drop in the curve for monochromatic albedo is noted for the point on the limb toward the ultraviolet end of the spectrum; and there is a lesser drop for the terminator. The difference in the curves of monochromatic albedo for the limb and terminator of Venus may explain the change in the color of the planet with phase, as well as the difference in violet absorption observed at different times. M.W.R.

N67-16807*# National Aeronautics and Space Administration, Washington, D. C.

OPTICAL PROPERTIES OF THE MARTIAN ATMOSPHERE FROM DATA OF PHOTOMETRIC OBSERVATIONS

N. P. Barabashov *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 43–51 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

An analysis of photometric data for Mars based on the theory of light scattering in planetary atmospheres indicates that the atmosphere probably has a low optical thickness. The scattering properties of the Martian atmosphere are chiefly in the visible region of the spectrum. The true absorption increases toward the short-wave end of the spectrum, although even here the optical thickness of the atmosphere is relatively low. Many areas in maria show a greenish hue. Author

N67-16808*# National Aeronautics and Space Administration, Washington, D. C.

SOME REMARKS ON HYPOTHESES OF AN ABSORPTIVE ATMOSPHERE ON MARS

V. V. Sharonov *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 52–60 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Models for the atmosphere and surface of Mars are reviewed that assume that the atmosphere has absorptive rather than scattering properties and that the red color of the planet is due to selective absorption in the atmospheric layer. The Carrer-Kiess hypothesis, which attributes selective extinction to nitrous oxide in the Martian atmosphere, is inadmissible since the absorption band for this compound in the spectrum of the planet is either absent or extremely weak. The model proposed by N. A. Kozyrev is not in accord with the observed brightness distribution along the radius of the disk as has already been pointed out in a number of articles. Opik's calculations are self-consistent, although they assume optical properties in the atmosphere that have no sound physical basis. It is considered extremely improbable that the Martian atmosphere has absorptive properties. Author

N67-16809*# National Aeronautics and Space Administration, Washington, D. C.

A MODEL FOR THE MARTIAN ATMOSPHERE AND PLANETARY SURFACE FROM THE STANDPOINT OF A HYPOTHESIS ASSUMING AN ATMOSPHERE WITH PURELY SCATTERING PROPERTIES

V. V. Sharonov *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 61–65 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

The author reviews the state of the art in attempts to apply photometric data for explaining the nature of Mars. It is pointed out that this problem has no unique solution since the relationship between brightness across the disk and optical characteristics of the atmosphere depends on atmospheric composition and structure. Thus all calculations of atmospheric characteristics such as optical thickness, mass and surface pressure are always based on some predetermined model. Since there is an infinite selection of possible models, analogy with terrestrial conditions is assumed to be most probable. This point of view gives preference to a model in which the visible region of the atmospheric spectrum is assumed to have purely scattering properties and the surface is considered to be covered with limonite dust. The nature of the polar caps and the violet layer are problems which are still unsolved. Author

N67-16810*# National Aeronautics and Space Administration, Washington, D. C.

SOME CONSIDERATIONS OF THE AEROSOL COMPONENT OF THE MARTIAN ATMOSPHERE

N. N. Sytinskaya *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 66–68 (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Particles suspended in a gas may have a strong effect on the scattering properties of the medium without changing its mass and density to any great extent. For this reason, photometric data on mass, density and surface pressure for the Martian atmosphere must be analyzed to isolate the contributions from gas and aerosol to the brightness of the atmospheric layer. Since there have been no satisfactorily reliable methods proposed for this purpose, the author reverses the process and uses pressure data obtained by other methods for a photometric study of the suspended particles. Author

N67-16811*# National Aeronautics and Space Administration, Washington, D. C.

ON THE AEROSOL COMPONENT OF THE MARTIAN ATMOSPHERE

E. G. Yanovitskiy *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 69–78 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Consideration is given to the discrepancy between data for the atmospheric pressure on the Martian surface from spectroscopic measurements and data for this pressure according to photometric and polarimetric observations. This difference is explained by the fact that light scattering by aerosol particles with radii $r \leq 10^{-6}$ cm is not considered when using photometric and polarimetric observations for determining surface pressure. The terrestrial atmosphere is used as an example to confirm this assumption. It is found that the number of aerosol particles with radii of the order of 10^{-6} cm in a column of Martian atmosphere with a base of 1 cm^2 is 10^{15} $1/cm^2$. It is shown that the Martian atmosphere has a higher saturation of fine particles of aerosol per unit of mass than that of the Earth. Author

N67-16812*# National Aeronautics and Space Administration, Washington, D.C.

THE [illegible] OF MARS AS A RESULT OF THE OPTICAL PROP[illegible]S OF ITS ATMOSPHERE

N. A. Kozyrev *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 79 (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Optical properties of the Martian surface are theoretically different from those of the earth in that any sufficiently bright Martian surface, regardless of color, would appear to be red because of the high atmospheric absorption. This is confirmed by spectrophotometric data of the surface and maria; and study of the atmospheric reflectivity as a function of wavelength results in a curve with a characteristic maximum close to 520 mu. The polar caps are considered to be atmospheric formations, and display about the same maximum. The light scattering particles in the Martian atmosphere are attributed to ice crystals or snow. M.W.R.

N67-16813*# National Aeronautics and Space Administration, Washington, D.C.

CHEMICAL COMPOSITION, PRESSURE AND TEMPERATURE OF THE MARTIAN ATMOSPHERE FROM DATA OF INFRARED SPECTROSCOPY

V. I. Morov *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 80 (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Infrared spectroscopy of Mars revealed a series of new $C^{12}O_2^{16}$ bands, the $C^{13}O_2^{16}$ band, and four new unidentified bands. The $C^{12}O_2^{16}$ bands at 1.6 and 2.05 μ give a product of CO_2 by pressure equal to 170 g/cm^2 mbar; and other studies have indicated the pressure in the Martian atmosphere is about 15 mbar close to the surface. It is, therefore, assumed that the pressure is in the 10 to 30 mbar range, which is considerably lower than previous estimates from photometric and polarization data.

N67-16814*# National Aeronautics and Space Administration, Washington, D.C.

BRIEF ANALYSIS OF A PHOTOMETRIC STUDY OF BRIGHTNESS DISTRIBUTION ACROSS THE MARTIAN DISK

I. K. Koval' *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 81–84 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

A brief analysis of research on darkening of the Martian limb is presented. It is pointed out that most observational photometric data is highly inaccurate because no allowance is made for the effect of image vibration. Thus, it is difficult to use these data for studying variations in the aerosol composition of the Martian atmosphere. Author

N67-16815*# National Aeronautics and Space Administration, Washington, D.C.

USING SPECTROPHOTOMETRIC DATA TO VERIFY THE HYPOTHESIS OF A LIMONITE COVERING ON MARS

I. I. Lebedeva *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 85–90 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

The author compares the spectral reflecting power for continents at the center of the Martian disk corrected for optical effects in the planetary atmosphere with that of terrestrial specimens measured at the Astronomical Observatory, Leningrad State University, in the 380–900 $m\mu$ range. It is shown that the curve for spectral reflecting power of limonite is similar to that of the Martian continents. Author

N67-16817*# National Aeronautics and Space Administration, Washington, D. C.

POLARIZATION STUDIES OF RADIO EMISSION FROM THE UPPER LAYER AND SURFACE COVERING OF THE PLANETS

A. Ye. Basharinov, M. A. Kolosov, and A. A. Kurskaya *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 95–96 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Polarization studies of inherent and reflected radio emission in the centimeter and decimeter bands were used to obtain information on the structure of the upper layer and surface coverings

of the planets. Polarization properties of the inherent radio emission from the moon in the centimeter range were used to obtain a more precise determination of the dielectric constant, and to evaluate the roughness of the upper surface layer. Similar data were obtained from polarization studies of radio echoes from Venus on a 12 cm wavelength. Instrumentation used for the polarization studies are mentioned; and other polarization data in the SHF range are briefly reviewed. L.S.

N67-16820*# National Aeronautics and Space Administration, Washington, D. C.
TAKING ACCOUNT OF SCATTERING ANISOTROPY IN DETERMINING THE OPTICAL PARAMETERS OF THE MARTIAN ATMSOPHERE AND SURFACE
A. V. Morozhenko and E. G. Yanovitskiy *In its* Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars. Jan. 1967 p 110–114 refs (See N67-16801 07-30) CFSTI: HC $3.00/MF $0.65

Absolute photometric data for spherical and elongated indicatrices are used for determining the optical parameters of the Martian atmosphere and surface. A comparison of these parameters shows that the optical thickness increases considerably with elongation of the scattering indicatrix (if the albedo for single scattering is close to unity). Author

N67-16901*# Santa Clara Univ., Calif.
AEROSPACE MECHANISMS
George G. Herzl, ed. 30 May 1966 350 p refs Proc. of the 1st Symp. held Santa Clara, Calif., 19–20 May 1966 Sponsored by JPL and Lockheed Missiles and Space Co.
(NASA-CR-81503; AD-638916) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Conference papers on aerospace mechanism design and development are presented. Emphasis is focused on the practical aspects, actual flight test data, and correlation with analytical predictions. For individual abstracts, See N67-16902 through N67-16927.

N67-16903*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXTENDIBLE BOOM DEVICE
W. C. Gamble *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 27–36 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

Requirements for extension devices for use in spacecraft configuration led to the preparation of a matrix analysis of all known mechanical means of deploying long booms from packaged extension systems. Requirements for high density packaging, deployment in a 1-g field, multiple extension and retraction, and high strength prompted development of a unique device which forms a beam from three rolls of metal tape, with the metal tape edges joined by Velcro tapes and snap fasteners. The mechanism was designed, fabricated, and successfully tested. Author

N67-16965# Air Force Satellite Control Facility, Sunnyvale, Calif.
VALIDATING VELA SATELLITE ORBIT DETERMINATION PROCEDURES USING OBSERVED ECLIPSE ENTRANCE TIMES
Charles B. Huelsman, III *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 32 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

The validation of orbit determination calculations was improved by using the observed time the satellite entered the shadow of the earth. This time can be predicted on the computer using the results of an orbit determination procedure; that is using the resulting vector. Theoretically, a vector is valid if $/t/<c/R/+k$, where t is the time difference, R is the number of revolutions elapsed since the eclipse for the vector in question, and c and k are constants. To test these guidelines and determine the constants c and k several eclipse predictions were made resulting in 248 (T,t) situations. The guidelines were found to be lacking. It was discovered that the data had not been corrected for the effect of the atmosphere on the shadow of the earth. Atmospheric corrections were calculated and the data was corrected. Validation guidelines were calculated and suggestions for improving the eclipse prediction program were made. Author

N67-17156# Boeing Scientific Research Labs., Seattle, Wash.
TROJAN ORBITS. II: BIRKHOFF'S NORMALIZATION
André Deprit, Jacques Henrard, and A. R. M. Rom Aug. 1966 61 p refs *Its* Math. Note No. 481
(D1-82-0564; AD-641128) CFSTI: HC $3.00/MF $0.65

In the Restricted Problem of Three Bodies for the system Sun-Jupiter, all terms of short and long period up to degree 13 are eliminated from the Hamiltonian expended in power series in the neighborhood of an equilateral center of libration. The normalizing canonical transformation expresses the Cartesian phase variables as double Fourier series in two angle coordinates whose coefficients are power series in the square roots of two action moments. In the normalized part of the transformed Hamiltonian, the angle coordinates are ignorable. It is shown how such a Birkhoff's normalization can be implemented automatically on a computer. As a first application, the characteristic exponents along the singular families of long and short period orbits originating at the equilibrium are developed as power series of the orbital parameter. Author (TAB)

N67-17166*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR I MISSION REPORT. PART III: TELEVISION DATA
R. H. Steinbacher, S. Z. Gunter, R. L. Spencer, D. R. Montgomery, L. D. Jaffe et al 1 Nov. 1966 291 p
(Contract NAS7-100)
(NASA-CR-81520; JPL-TR-32-1023) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Some 281 selected television photographs of the lunar surface, as acquired by and sent from Surveyor I between June 2 and July 14, 1966, are presented. Accompanying information provides assistance in the interpretation of these pictures. The supporting material comprises descriptions of the television subsystem, the orientation of camera and sun, the ground photo recording system, and camera parameter information. In addition, 32 preliminary mosaics aid with spatial relationship interpretation. Author

N67-17177*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PRESTO II: A DIGITAL COMPUTER PROGRAM FOR TRAJECTORY OPTIMIZATION
Richard C. Rosenbaum and Zoe Taulbee Washington, NASA, Feb. 1967 71 p refs
(Contract NAS1-5255)
(NASA-CR-686) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Program speed is obtained through the use of an approximate analytic solution to the three-dimensional equations of motion on a cylindrical earth. The thrust attitude control history is assumed to follow the linear-tangent law. The method of steepest descent is used to determine the control parameters that maximize payload while simultaneously satisfying terminal constraints. Author

N67-17236# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
LYAPUNOV STABILITY AND SOLAR PERTURBATIONS OF A PASSIVELY DAMPED GRAVITY-GRADIENT SATELLITE

Peter M. Bainum, Davinder K. Anand, and Donald L. Mackison Sep. 1966 76 p refs
(Contract NOw-62-0604-c)
(TG-854; AD-642619) CFSTI: HC $3.00/MF $0.65

The rotational equations for a satellite and two gimballed damper booms connected at the center of mass are derived using Lagrange's general formulation. The complete motion is thus governed by five coupled equations where the translational orbital motion of the system is assumed not coupled with the rotational motion. Included are the conservative effects of both gravitational and gyroscopic torques. The latter results from the coupling between orbital angular velocity and the rotational motion in pitch-roll-yaw referenced to a local vertical frame. The motion occurs in the presence of small dynamic and instantaneous perturbations. The dynamic inputs are (1) interaction of solar radiation on extendible booms for varying moment of inertia parameters for gravity stabilization, and (2) periodic excitation due to eccentricity. The first yields time-dependent radiation torques and moment of inertia corrections caused by in- and out-of-plane bending due to thermal unbalance. The orbital eccentricity causes a once per orbit parametric excitation about each axis. Finally, the instantaneous perturbations, considered as step inputs, occur when the satellite emerges from the earth's shadow. TAB

N67-17268 Chicago Univ., Ill. Inst. for Computer Research.
POLARIZATION IN STELLAR DYNAMICAL SYSTEMS
R. H. Miller *In its* ICR Quart. Rept., No. 9 1 May 1966 9 p refs (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

Differences between two nearly identical stellar dynamical systems are studied. A displacement of a star in one system induces dipolar forces in the difference system; the resulting change of motion of the neighboring stars polarizes the difference medium in such a way as to screen distant stars while leading to an exponentially growing displacement. Forces in a stellar dynamical system are balanced so that moving one star causes the surrounding stars to move collectively (polarize the medium) in such a way that their reaction on the original star enhances the initial displacement. Orbits are affected in the sense that for any orbit there exists another orbit, initially arbitrarily close, which departs from it with a separation increasing exponentially with the time. Epicyclic motions and random velocities tend to reduce the growth rate. Some consequences of the polarization are discussed in a preliminary way. Author

N67-17269 Chicago Univ., Ill. Inst. for Computer Research.
RELAXATION IN A MODEL CLUSTER
R. H. Miller *In its* ICR Quart. Rept., No. 9 1 May 1966 4 p refs (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

The interplay of the various factors affecting relaxation times in a star cluster is explored by integrating along orbits of different energies and angular moments. Plummer's model provides the potentials for the orbits. Orbits of low angular momentum relax faster than orbits of the same energy with high angular momentum. Author

N67-17321*# Wisconsin Univ., Madison. Mathematics Research Center.
LECTURES IN APPLIED MATHEMATICS. VOLUME VI: SPACE MATHEMATICS, PART 3
J. Barkley Rosser Providence, Am. Mathematical Soc., 1966 269 p refs Proc. of the Summer Seminar in Appl. Math., Held in Ithaca, N. Y., 1963; Sponsored by Am. Mathematical Soc.
(Grant NsG-358; Contracts DA-31-124-ARO(D)-82; AT(30-1)-3164; Grants Nonr(G)-00025-63; AF-AFOSR-258-63)
(NASA-CR-81531) CFSTI: HC $3.00/MF $0.65 CSCL 03C

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7. THE STABILITY OF A ROTATING LIQUID MASS J. A. O'Keefe (NASA. Goddard Space Flight Center) p 155–169 refs (See N67-17328 07-12)

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N67-17322*# Boeing Scientific Research Labs., Seattle, Wash.
MOTION IN THE VICINTITY OF THE TRIANGULAR LIBRATION CENTERS
Andre Deprit *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 1–30 refs (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

The restricted problem of three bodies was used to analyze periodic librations of a planetoid around a triangular equilibrium point. It was assumed that two masses move in circular orbits under their mutual gravitation, while a third body of negligible mass is acted upon by the first two masses, but does not move in the same plane. First order general librations around the triangular equilibrium are presented, and the Fourier series are computed up to the third order for long and short period librations in the Sun–Jupiter system as well as in the Earth–Moon system. G.G.

N67-17323*# General Electric Co., Philadelphia, Pa.
MOTION OF A PARTICLE IN THE VICINITY OF A TRIANGULAR LIBRATION POINT IN THE EARTH–MOON SYSTEM
J. Pieter de Vries *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 31–69 refs (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

The motion of a particle in the vicinity of the Earth–Moon triangular libration point is studied by forming analytical expressions for certain variables as functions of the independent variable time under consideration of the gravitational force of the sun and the moon's orbital eccentricity. Motion equations are derived from a formulation of the problem in Jacobi coordinates and a slight digression is made by writing the equations for the main problem in rotating rectangular coordinates attached to the libration point 60° ahead of the moon. It is shown how the two fundamental frequencies are derived and how these are changed by the introduction of the sun's attraction. Solution begins with the introduction of Delaunay elements as variables, and the libration terms encompass motion in mean longitude and also the variation of the semi-major axis. The dependence of the libration frequency on the amplitude is demonstrated. G.G.

N67-17324*# Liverpool Univ. (England).
THE DOMINANT FEATURES OF THE LONG-PERIOD LIBRATIONS OF THE TROJAN MINOR PLANETS
P. J. Message *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 70–78 (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

The problem of three bodies possesses a class of solutions in which the bodies move so that the triangle they define is always equilateral, as was shown by Lagrange. This type of solution found application in the study of the solar system with the discovery of minor planets moving so as to approximate such a configuration with the Sun and Jupiter. These planets are known as the "Trojan planets," and are named after heroes of the Trojan War. The present treatment seeks to present the long period features of motion in the vicinity of the equiangular triangle configurations, making use of the elements of an osculating orbit, and methods taking into account only the gravitational attractions of the Sun and Jupiter, which of course dominate the motion. Author

N67-17325*# Cincinnati Univ., Ohio.
OUTLINE OF A THEORY OF NONPERIODIC MOTIONS IN THE NEIGHBORHOOD OF THE LONG-PERIOD LIBRATIONS ABOUT THE EQUILATERAL POINTS OF THE RESTRICTED PROBLEM OF THREE BODIES
Eugene Rabe *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 79–101 refs Sponsored by NASA (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

In the rotating coordinate frame of the restricted problem of three bodies, all motions which are nonperiodic, but of a librational nature relative to one of the equilateral points, are treated as oscillations about given periodic solutions of long period. On the basis of the Fourier series representation of the periodic reference orbit, the displacements from this intermediate orbit take the form of infinite series of periodic terms, with coefficients proceeding essentially in powers of those of the principal terms of short period established in the first, linear approximation. It appears that the stability of such nonperiodic librations will be endangered only when the predominant oscillations are so large as to prevent the convergence of the series proceeding in powers of their amplitudes. The results also prove the "higher order stability" of the periodic orbits themselves, beyond the first-order stability previously proved on the basis of Hill's (linearized) equation. Author

N67-17326*# Cincinnati Univ., Ohio.
ELEMENTS OF A THEORY OF LIBRATIONAL MOTIONS IN THE ELLIPTICAL RESTRICTED PROBLEM
Eugene Rabe *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 102–118 refs Sponsored by NASA (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

Nonperiodic librational motions in the restricted problem of three bodies as oscillations about a given periodic reference orbit are extended here to the case where the relative motion of the two finite masses is elliptic. The new reference orbit combines a periodic solution of the restricted problem with a periodic scale factor as determined by the periodically changing linear dimensions of the equilateral triangles. The equations of motion are referred to a nonuniformly rotating coordinate system, the x-axis of which coincides permanently with the straight line connecting the two finite masses, but the integrations are facilitated by expansions in powers of the eccentricity e of the fundamental elliptic orbit. While the chosen reference orbit as such is not a particular solution of the differential equations, the remaining superposed oscillations are found to consist of a forced and a free part, where only the latter one can be reduced to zero by an appropriate choice of the constants of integration. Author

N67-17327*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EQUILIBRIUM SHAPE OF THE EARTH IN THE LIGHT OF RECENT DISCOVERIES IN SPACE SCIENCE
John A. O'Keefe *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 119–154 refs (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

Calculations are performed for the flattening of a body whose polar moment of inertia C is given. The difference between C and the axial moment of inertia A (the quantity C–A), the hydrostatic value of the flattening ϵ was used to find an equation between C and ϵ by stipulating that the quantity $(C-A)/Ma^2 = J_2$ is equal to $2/3\ (\epsilon - 1/2m)$, where m is the ratio of centrifugal force to gravity at the equator, and where M is the mass of the earth. Since hydrostatic flattening of the earth depends only on the assumed value of the polar moment of inertia, this can be determined by measurements of $(C-A)\ Ma^2$ and also of (C–A) from satellite orbits; the quotient of these measurements is then C/Ma^2, from which the hydrostatic flattening is readily determined. G.G.

N67-17329*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
GEODETIC PROBLEMS AND SATELLITE ORBITS
W. H. Guier *In* Wis. Univ. Lectures in Appl. Math., Vol. VI 1966 p 170–211 refs (See N67-17321 07-30) CFSTI: HC $3.00/MF $0.65

The principal topic to be discussed in this chapter is the effect of geodetic errors on the time dependence of satellite tracking data as received by a tracking station located on the surface of the Earth from a near-earth satellite. These geodetic errors fall into two categories, geodetic errors which affect the location of the tracking station on the surface of the Earth and geodetic errors which affect the motion of the satellite. Consequently, subsidiary topics which shall be discussed are: (1) Methods for specifying the motion of a tracking station in inertial space, given the usual geodetic measurements available for a point on the earth's surface, (2) The motion of a near-earth satellite when influenced by the various harmonics of the earth's gravity field (geopotential), and (3) The functional dependence of various types of tracking data upon the trajectories of the station and satellite in inertial space. Author

N67-17394*# National Aeronautics and Space Administration, Washington, D. C.
LAUNCHING PROGRAM AT ADELIE LAND, DECEMBER 1966 TO FEBRUARY 1967 [CAMPAGNE DE TIRS EN TERRE-ADELIE, DECEMBRE 1966–FEVRIER 1967]
Jan. 1967 16 p Transl. into ENGLISH from FRENCH (NASA-TT-F-10613) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The launching program of the French Dragon sounding rocket from Adelie Land is outlined briefly, with position maps, payload diagrams, and vehicle sketches. Scientific objects primarily concern determination of the anomalies in the upper atmosphere, centering over the magnetic noon. Data collection and reduction is believed to be facilitated by the favorable position of the French Polar Expedition Station at Dumont d'Urville, within the polar cap of highly deformed lines of force of the earth's magnetic field and practically coinciding with the inclination pole where the magnetic field in the vicinity of the ground surface is vertical. Scientific equipment for measurement of electron density and electron temperature, spectrometry of electrons and protons, and ionization mechanism is described, followed by a brief discussion of the configuration of the vehicle, flight sequence, general launch conditions, and program contractors. Author

N67-17537# California Univ., Livermore. Lawrence Radiation Lab.
REMARKS ON STELLAR EVOLUTION. PART III: INTERPRETATION OF AXIAL ROTATIONS

E. Schatzman Apr. 1966 19 p refs Transl. into ENGLISH from Ann. Astrophys. (Paris), v. 17, 1954 p 300–311
(UCRL-TRANS-10040; Pt. III)

Assuming that the stars in the first part of the main sequence are formed by the contraction of large rotating masses, it is shown that it is possible to explain quantitatively the observed distribution of rotational velocities for stars of different spectral types in the first part of the main sequence. The pre-stellar medium is turbulent. Author (NSA)

N67-17538# California Univ., Livermore. Lawrence Radiation Lab.
REMARKS ON STELLAR EVOLUTION. PART V: ON THE FORMATION OF STELLAR SYSTEMS
E. Schatzman Apr. 1966 27 p refs Transl. into ENGLISH from Ann. Astrophys. (Paris), v. 17, 1954 p 382–397
(UCRL-TRANS-10041, Pt. V)

If one considers the internal and turbulent energy of gas masses capable of separation into stars by gravitational consideration, it seems that the energy of stellar systems thus formed is necessarily negative. A non-stationary aggregation leads to a stellar escape about fifteen times greater than in the case of a stationary grouping; the residue is a system with large negative energy. The formation of stationary aggregations, or aggregations with positive energy, is not compatible with the proposed model. Author (NSA)

N67-17633*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPUTER PROGRAM TRAJECTORY OPTIMIZATION BY EXPLICIT NUMERICAL METHODS
James W. Hilliard 8 Dec. 1966 95 p refs
(NASA-TM-X-53552) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A computer program is detailed that calculates minimum time required for a space vehicle to meet its mission while in an optimum trajectory and can maximize an option if the burning time is fixed. The vehicle motion, assumed to be in a plane, is described by two linear differential equations. A precoded subroutine, Runge–Jutta fourth order, is used to integrate the equations of motion. Numerical methods are employed to determine the deviation in constraining functions explicitly in terms of first and second order variations in thrust angle. An iteration method is employed which, when computed, provides the effect of first and second order variations in addition to the usual numerical solution to the differential equations. Author

N67-17676# RAND Corp., Santa Monica, Calif.
THE ECONOMIC IMPACT OF REUSABLE ORBITAL TRANSPORTS ON THE COST OF PLANNED MANNED SPACE PROGRAMS, 1970–1999
A. Frank Watts, D. J. Dryfuss, and H. G. Campbell 15 Nov. 1966 9 p
(P-3465; AD-642677) CFSTI: HC $3.00/MF $0.65

In a major earth orbital program involving the placing into orbit of approximately 72 million pounds between 1970 and 1999, it is more economical to use the current expendable Saturn IB and Saturn V launch vehicles than to develop and operate either a conventional or advanced reusable orbital transport. The reason for this is that even on an ambitious program there is insufficient payload to compensate for the high development cost of a reusable transport. This conclusion is also true if the Stage 1 and Stage 2 propulsion development costs were charged to another unrelated program. Assuming the reusable orbital transport were justified for other reasons the funding pattern for the development of the propulsion systems and air-frame between 1970 and 1980 exceeds that of the most optimistic program presently under consideration, that is, the landing of manned modules on Mars in 1984, a program in which the reusable orbital transport plays little or no role. The reusable orbital transports considered in this study are payload limited in both weight and volume. Out of a total of 72 million pounds, the rot was able to accommodate only 21 million pounds, the remainder being launched by the Saturn V as is presently planned. Substitution of ROTS for Saturn VS is not only infeasible in most cases but also uneconomical since seven reusable transports are necessary to match the same payload as a Saturn V class vehicle. TAB

N67-17746# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE SHAPE OF THE MOON AS DEDUCED FROM THE ORBITER DETERMINATION OF ITS GRAVITATIONAL FIELD
C. L. Goudas, Zdenek Kopal, and Zdenka Kopal Oct. 1966 9 p refs *Its* Mathematical Note No. 485
(D1-82-0570; AD-643975) CFSTI: HC $3.00/MF $0.65

Preliminary values of the lunar gravity field as obtained from an analysis of the tracking data of Lunar Orbiter 1 are used to express the basic features of the figure of the Moon. Some tentative conclusions are drawn regarding the homogeneity, the non-hydrostatic form, and the solidity of the lunar globe. Author (TAB)

N67-17757# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS IN COSMONAUTICS PRIOR TO TAKING OFF INTO OUTER SPACE
N. Mironova 24 Aug. 1966 10 p Transl. into ENGLISH from Leningr. Pravda (Leningrad), 18 Aug. 1963 p 3
(FTD-HT-66-123; TT-67-60261; AD-643736) CFSTI: HC $3.00/MF $0.65

Translation of Russian article: Problems in cosmonautics prior to taking off into outer space. Author (TAB)

N67-17787*# Harvard Coll. Observatory, Cambridge, Mass.
SPECTRAL LINE RADIO ASTRONOMY MEASUREMENTS
Hays Penfield *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 105–121 refs (See N67-17781 07-14) GPO: HC $1.00; CFSTI: MF $0.65

Fundamental principles of radio astronomy and radio telescope operation are reviewed as background for considering the requirements of the special instrumentation used in detecting and analyzing certain narrowband or spectral line radio astronomical signals. General types of continuum flux behavior are discussed, along with the many very sharp changes in flux which occur in narrow regions of the radio spectrum. The particular receiving systems used in spectral line radio astronomy are examined. Criteria for these are listed as low system noise temperature; excellent gain and frequency stability; flexibility in frequency resolution and frequency tuning; precise measurement of the received frequency; and a true picture of the spectral power density distribution in received signals. Attention is focused on a multichannel spectral line receiver, and on the digital autocorrelation spectral line radiometer. Illustrations of typical interstellar spectral line profiles are given. M.G.J.

N67-17793*# Johns Hopkins Univ., Baltimore, Md.
ULTRAVIOLET MEASUREMENTS IN PLANETARY ATMOSPHERES
William G. Fastie *In* NASA. Electron. Res. Center Aerospace Meas. Tech. 1967 p 203–216 refs (See N67-17781 07-14) GPO: HC $1.00; CFSTI: MF $0.65

The techniques and optical components which are employed in ultraviolet space measurements are described, and some of the experimental data which have been obtained are presented. The instrumentation considered is applicable to all spectral ranges above the cutoff wavelength of lithium fluoride windows at about 1050 Å. Specific areas receiving emphasis include energy relationships, unit of brightness, differential filter photometry below

2000 Å. Ebert spectrometer properties, measuring circuits, and collecting optics. A.G.O.

N67-17827*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRAJECTORY ANALYSIS OF AN EARTH–VENUS–MERCURY MISSION IN 1973
F. M. Sturms, Jr. 1 Jan. 1967 62 p refs
(Contract NAS7-100)
(NASA-CR-81636; JPL-TR-32-1062) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The report gives the results of a preliminary study of trajectory and guidance considerations for an Earth–Venus–Mercury mission in 1973. The mission utilizes a trajectory having a close encounter with Venus en route to Mercury in order to reduce launch energy requirements. Conic trajectory data are presented for the region of possible trajectories having launch energies (C_3) less than 21 km^2/sec^2. Integrated trajectory data and near-planet geometry are presented for selected mission designs. Based on a maximum C_3 of 19.6 km^2/sec^2 and a constant Venus arrival date of February 5, 1974, the resulting launch period is 23 days long, extending from October 20 to November 11, 1973. The total flight times range from 131 to 165 days, with Mercury encounter near the end of March 1974. The mission can be accomplished with Earth-based radio tracking and three midcourse corrections at times about 6 days after injection, 6 days before Venus encounter, and 8 days after Venus encounter. Statistics are presented for the three midcourse corrections and associated target errors. A total midcourse velocity capability of about 120 m/sec is required. The final rms miss at Mercury ranges from 1400 to 2900 km. Author

N67-17919# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
THE CONFERENCE ON GRAVITY IN TIFLIS [GRAVITATSIONNAYA CONFERENTSIYA V TBILISI]
G. S. Bisnovatyy-Kogan 1966 10 p refs Transl. into ENGLISH from Lemlya i Vselennaya (Moscow), no. 5, 1965 p 71–73
Papers Presented at the Second Conf. on Gravity, Tiflis, USSR, 1965
(ACIC-TC-1115; TT-66-62583; AD-641755) CFSTI: HC $3.00/MF $0.65

Papers presented at the Conference are reviewed. TAB

N67-17961*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.
ANALYTICAL METHODS AND OBSERVATIONAL REQUIREMENTS FOR INTERPRETATION OF ASTEROID DISTRIBUTIONS
J. E. Ash Dec. 1966 58 p refs
(Contract NASr-65(06))
(NASA-CR-81678; P-14) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Questions are raised whether ordering mechanisms exist capable of arranging the asteroids in some identifiable distribution, or whether the asteroidal material is more or less randomly distributed throughout an essentially toroidal ring extending from Mars to Jupiter. The conclusion is reached that the planets, in particular Jupiter, exert small perturbing forces which over long periods of time produce distinctive distributional features. These features are deterministic, and through suitable interpretation, the mechanical history of solar system events may possibly be traced back through time and contribute to the understanding of the solar system origins. The deeper understanding of distributional features can also be of value for the prediction of possible hazards to interplanetary space missions. General methods of analysis for the interpretation of asteroid observational data are outlined, and further observations to extend and support existing hypotheses and theoretical approaches are recommended. Author

N67-17967*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA BOOK FOR ENVIRONMENTAL TESTING AND SPACECRAFT EVALUATION, VOLUME 2
[1965] 114 p refs
(NASA-TM-X-59347) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Scientific and engineering data on space and launch environments are summarized for the purpose of keeping engineers abreast of pertinent developments in NASA programs and providing a reference book for environmental testing and spacecraft evaluation. A glossary is presented containing definitions of common space terms as well as definitions which particularly apply to environmental test and evaluation activities. Also included is an international log of space launches which contains key data on launches since the first Soviet shot on 4 Oct. 1957. A.G.O.

N67-17976* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
TABLES OF PLANE GALACTIC ORBITS
G. Contopoulos and B. Stroemgren 1965 185 p refs
(Contract Nonr-1858(33))
(NASA-TM-X-59344) CFSTI: HC $3.00 CSCL 03C

Tables are presented for calculating the plane orbits of stars that pass near the sun, so that their place of origin can be approximated. Consideration is given to the derivation of orbital functions and the construction of a galaxy model. The tabulated orbits cover a range of initial velocities in the direction of galactic rotation from 190 km/sec to 270 km/sec with steps of 10 km/sec and a range of radial velocities from −100 km/sec to +100 km/sec. A.G.O.

N67-17980*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
RESEARCH REPORTS, JULY 1, 1964–JUNE 30, 1965
30 Jun. 1965 114 p refs
(NASA-TM-X-59345) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A compilation of research reports in the areas of astronomy and geophysics is presented. Emphasis is placed on nucleosynthesis, stellar structure and evolution, the origin and development of the solar system, and solar-terrestrial relationships. Included are basic studies in atmospheric dynamics, the theory of turbulence, convection, and radiative transfer. C.T.C.

N67-17983*# Sandia Corp., Albuquerque, N. Mex.
A MODEL FOR PLANETARY QUARANTINE REQUIREMENTS
E. J. Sherry and C. A. Trauth, Jr. Sep. 1966 60 p refs
(NASA Order R-09-019-040)
(NASA-CR-81656; SC-RR-66-588) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A model is developed which relates general planetary exploration objectives to spacecraft-oriented planetary quarantine requirements (sterility levels). This model is somewhat more realistic than previous models in that it considers only a finite number of missions. When only finitely many missions are envisioned, the probability that a mission contaminates the planet is highly dependent upon the probability of mission success. So much so, in fact, that for certain (not unreasonable) parameter values, it is impossible to obtain a sterility level. In many other cases, even when a level can be obtained, it is impracticably severe. This suggests that further investigation will be needed before agreement is reached about spacecraft sterility levels. Author

N67-17997# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
RECENT WORK ON STELLAR INTERIORS A BIBLIOGRAPHY OF MATERIAL PUBLISHED BETWEEN 1958 AND MID-1966

Edward Langer, Margaret Herz, and J. P. Cox 9 Dec. 1966 122 p refs
(Contract DA-31-124-ARO(D)-139; Grant NSF GP-4859; Project DEFENDER)
(NASA-CR-81654; JILA-88) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A bibliography of recently published material on stellar interiors is presented and includes references to texts and other general material as well as articles on physical conditions and processes in stellar interiors, proto-stars and evolution prior to nuclear burning, equilibrium star models and evolution during nuclear burning, evolutionary stages beyond nuclear burning, and rapidly changing stars. Also included are a table of stellar models and an author index. R.N.A.

N67-18007*# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
RADAR STUDIES OF THE LUNAR SURFACE EMPHASIZING FACTORS RELATED TO SELECTION OF LANDING SITES Status Report, 1 Jul.–31 Dec. 1966
Jan. 1967 37 p refs
(Grant NGR-33-010-024)
(NASA-CR-81718; CRSR-260) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Investigation of the characteristics of the lunar surface are reported, and details are given on the mapping of the lunar surface at 430 Mc/s (λ = 70 cm) and measurement of the radar cross section of the moon at 40 Mc/s (λ = 7.5 m). The mapping of radar reflectivity of the lunar surface at 430 Mc/s, with a resolution on the lunar surface of 5 to 10 km, is described. A normalized reflectivity was mapped, so that a change in radar reflectivity could be directly related to a local change in lunar surface. It is hoped that by observing the expected and depolarized components it will be possible to establish whether this change is due to a change in roughness. Technical aspects of the mapping studies are discussed, a time scheduling for the study is included, and future research plans are outlined. L.E.W.

N67-18044* Volt Technical Corp., Washington, D. C.
INITIAL RADIUS OF AN IONIZED METEOR WAKE [NACHAL'NYY RADIUS IONIZIROVANNOGO METEORNOGO SLEDA]
V. N. Lebedinets and Yu. I. Portnyagin 19 Sep. 1966 8 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 4, 1966 p 713–716
(Contract NAS5-12487)
(NASA-CR-81706; ST-IM-10515) CSCL 03B

Taking into account the dependence of the effective diffusion cross section of meteoric atoms in the atmosphere on meteor velocity, the initial radius of an ionized meteor wake is computed. Inasmuch as the initial widening of the wake takes place mainly at the expense of the first few path lengths of vaporized particles, the initial contribution to the initial radius of individual paths is considered. The obtained values of the initial radius R_i satisfy the condition $0.93\ l_0 < R_H < 1.5\ l_0$; where l_0 is the length of the free path of vaporized particles for a given velocity of meteors. The computed values of the initial radius are in good agreement with the results of radar measurements of the initial radius conducted in Khar'kov, Kiyev and Jodrell Bank. Author

N67-18063 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-Sous-Bagneux.
OPTIMAL IMPULSE TRANSFERS BETWEEN NEAR CIRCULAR NON-COPLANAR CLOSE ORBITS [TRANSFERTS INFINITESIMAUX IMPULSIONNELS ECONOMIQUES ENTRE ORBITES QUASI-CIRCULAIRES NON COPLANAIRES]
Jean-Pierre Marec Oct. 1966 79 p refs In FRENCH; ENGLISH, GERMAN and RUSSIAN summaries Presented at the 17th Intern. Congr. of Astronautics, Madrid, 9–5 Oct. 1966
(ONERA-TP-392) CFSTI: $3.00

The first order solution relative to the problem of economical transfers (minimum characteristic velocity, time open) between near-circular noncoplanar close orbits is determined analytically by linearization around a circular nominal orbit. Depending on the transfer to obtain, this solution belongs to one of the four following types: two well-defined impulses, two well-defined impulses applied at the nodes, tangential thrust, and thrust lying in one of the two planes tangent to the orbit and making angles of $\pm 30°$ with the local horizontal plane. For these two last types, the linearized solution degenerates: a certain freedom exists in the choice of the points of application and of the magnitude of the thrust which can even be continuous, modulated or not. However, the optimal transfer can always then be realized with the use of two impulses only. The preceding degeneracy disappears if the linearization is no longer made around a circular nominal orbit but around a near-circular one. Then, the corresponding solutions are one-, two- or three impulse solutions. The reachable domain (set of transfers which can be obtained with a given characteristic velocity) is analyzed in detail. Author

N67-18074*# National Aeronautics and Space Administration, Washington, D. C.
HANDBOOK FOR CONTAMINATION CONTROL ON THE APOLLO PROGRAM
Aug. 1966 192 p refs
(NHB-5300.3) GPO: HC $1.50; CFSTI: MF $0.65 CSCL 22A

A handbook containing the basic factors in the design and application of a clean room is presented in detail. The designer's role and responsibility for contamination control is stressed. Contamination is defined as any unwanted foreign material referenced against absolute purity and is classed in four categories: particulate, chemical, biological, and energy or change of state. The need for and use of controlled environments as a manufacturing tool is mentioned, and facility design and construction is described. Other areas considered are operation, personnel selection and training, cleaning, and precision packaging. Tools, techniques, and procedures developed by the microbiologist for controlling effects of living organisms are also examined. S.P.

N67-18091* Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
RECENT ADVANCES IN X-RAY ASTRONOMY
B. B. Rossi Oct. 1966 40 p refs Presented at Intern. Astron. Union Symp. No. 31, Noordwijk, Netherlands, 25 Aug.–1 Sep. 1966
(Grant NsG-386)
(NASA-CR-81747) CFSTI: $3.00 CSCL 03A

New astronomical X-ray sources discovered since December 1965, some of which have been tentatively identified with known galactic or extragalactic objects are discussed. Evidence is presented for a variability in the X-ray flux received from at least one of the sources. New spectral information was obtained. New observations of the strong X-ray source in Scorpio (Sco X-1) have greatly reduced the previous upper limit for its angular size and provides a much more accurate determination of its angular coordinates. This determination has led to the identification of Sco X-1 with a faint visible object whose peculiar properties had escaped the attention of optical astronomers. Author

N67-18193*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NONSINGULAR ORIGIN OF THE UNIVERSE
E. R. Harrison [1965] 9 p refs Submitted for Publication
(NASA-TM-X-57251) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The theory that the universe originated from or passed through a space-time singularity of infinite density some 10^{10} years ago is examined. Because attempts to quantize the gravitational field encounter both formal and conceptual difficulties, qualitative arguments are adopted that show it is unlikely that the universe originated as a singularity. A.G.O.

N67-18198*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
COOLING AND DETECTABILITY OF NEUTRON STARS
Sachiko Tsuruta and A. G. W. Cameron [1965] 76 p refs Submitted for Publication
(NASA-TM-X-57318) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Surface properties, temperature effects, cooling behavior, and observability of neutron stars were studied. For this purpose the opacity of the surface layers was calculated both for a pure iron and a pure magnesium composition. It was found that the non-degenerate layers are only a few meters thick and in no case exceed 1% of the stellar radius. The star cools mainly through neutrino emission when $T \geq 1 \approx 4 \times 10^8$ °K, but at lower temperatures the cooling is primarily through electromagnetic radiation. The neutrino cooling mechanisms included were the neutrino plasma process, the URCA process, and the neutrino bremsstrahlung process. The cooling behavior is quite complicated. The rate of cooling generally depends on mass, nuclear potential, and surface composition, among which the dependence on mass is the most significant. It will be hard to observe low mass neutron stars due to fast cooling rates. However, medium and high mass stars should still have temperatures exceeding about 2×10^6 °K on the surface for times of the order of 10^3 to 10^5 years. Hence it should not be impossible to observe massive neutron stars relatively close to us, if there is no X-ray emission of larger flux coming from the surrounding region. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-16908*# McDonnell Aircraft Corp., St. Louis, Mo.
GEMINI/AGENA DOCKING MECHANISM
P. H. Meyer *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 81–90 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

The Gemini/Agena docking mechanisms utilize simple mechanical elements to provide a capability for initial engagement between two orbiting vehicles. The docking mechanisms then rigidize the attachment in a manner suitable for subsequent maneuver with the Agena propulsion system. Finally, the mechanisms provide a capability for disengaging and repeating the entire docking cycle. The mechanical elements used are found in daily terrestrial applications. Author

N67-16914*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER-IV SCIENCE PLATFORM STRUCTURE AND ACTUATOR DESIGN, DEVELOPMENT AND PERFORMANCE
G. Coyle and E. Floyd *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 145–156 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65
(Contract NAS7-100)

Equipment test results and flight experience are summarized to support the discussion of design adequacy. The scan structure and actuator design are considered to be a reasonable solution within the framework of schedule, structural efficiency, interface definition, and, most important, desired functional objectives. The design techniques and problem areas described are considered to be useful data for application to future spacecraft programs. Author

N67-16922*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ZERO-G TESTING OF SATELLITE INSPECTION MECHANISMS
R. N. Lahde and J. W. Lebold (Lockheed-Calif. Co.) *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 251–262 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65
(Contract AF 33(657-10466)

Some results are presented of a study concerned with the methods and means of testing the mechanisms needed in support of docking operations, with particular emphasis on inspection of noncooperative targets. The emphasis on noncooperative targets introduces an element of uncertainty and risk into the docking operation, which reflects in the flexibility and versatility necessary for the docking systems. It also reflects on methods and types of facilities required to test components and systems for such operations. Author

N67-16969# Air Force Systems Command, Los Angeles, Calif. Space Systems Div.
GEMINI PERFORMANCE OPTIMIZATION
John D. Regenhardt *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 19 p (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

A technique known as Real Time Performance Computation (RTPC) for providing accurate booster performance information during the countdown is described. This information is used in several ways. First, it makes accurate performance information available to the Mission Director and the Launch Director. Thus, their decisions concerning performance are based on the most accurate data available rather than estimates. In addition, the RTPC system generates data that enables the launch crew to take appropriate action to improve performance. The idea in this case is to regulate propellant temperatures by using insulating wraps so that the optimum temperature combinations exist at lift-off. Finally, the RTPC system keeps track of the ullage volumes. Again, positive action can be taken to prevent the violation of an ullage limit. The system has proved very beneficial to the Gemini program. It has provided the equivalent of significant performance improvements without adding to the program cost. Author

N67-17186*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Aerospace Sciences Lab.
DEVELOPMENT OF THE THERMAL-VACUUM TESTING TECHNIQUES FOR SPACECRAFT AT HIGH SOLAR INTENSITIES Interim Technical Summary Report
Dec. 1966 91 p refs
(Contract NAS2-3164)
(NASA-CR-73066; Rept.-4-06-66-14) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This interim report presents the results of analytical studies and preliminary investigations directed toward the specification of test procedures and techniques to be used for high-intensity thermal testing of a solar probe spacecraft. The spacecraft thermal response analysis yielded analytical thermal models of two candidate configurations which may be used for predicting spacecraft temperature response under actual and simulated thermal-vacuum environmental conditions. Complete details of the thermal models and their application for solution by computer are provided herein. A second major area of study was the investigation of methods for simulating the environmental conditions during thermal-vacuum testing of the spacecraft. Energy source characteristics for the

methods of simulation were determined for a limited number of sources, and a preliminary estimate of temperature error due to spectral mismatch between solar simulation sources and the sun's spectral energy distribution has been made. Author

N67-17302# TRW Systems, Redondo Beach, Calif.
BOOSTER ROCKET ALTITUDE ABORT PROGRAM Final Report
H. J. Carpenter, R. S. Ottinger, J. B. Peterson, K. L. So, and L. J. Van Nice Jul. 1966 152 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-66-2047) CFSTI: HC $3.00/MF $0.65

Analytical models were developed for the prediction of the prompt fireball blast environment and late fire-stream thermal environment of an altitude booster abort. The prompt fireball model for cryogenic and hypergolic propellants was based on the analysis of experimental liquid propellant vehicle abort data and theoretical analyses of the effect of vehicle motion on blast characteristics. The late firestream model was based on theoretical descriptions of turbulent wake flow. The nature and probability of solid rocket booster aborts also were assessed. In the interest of rapid safety hazard assessment, the calculation of the spatial distribution of the temperature and energy release-time history of fireballs resulting from booster propellant aborts at altitudes of 10,000 to 70,000 feet was reduced to graphical form. Author (NSA)

N67-17501*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AEROBEE 150 PROPULSION FAILURE
J. R. Busse and P. S. Bushnell, Jr. Washington, NASA, Feb. 1967 42 p refs
(NASA-TN-D-3359) CFSTI: HC $3.00/MF $0.65 CSCL 22D

NASA vehicle 4.113 GA-GI, an Aerobee 150 launched from the White Sands Missile Range, New Mexico in April 1964, experienced a "hard" start (an explosive initial combustion generating high chamber pressures) which resulted in other anomalies, including a tail can explosion after 27 seconds of flight. The most probable cause of the hard start was an improper rupture sequence of the fuel and oxidizer diaphragms which could have resulted from an improper fuel bleed or manufacturing discrepancies. As a result of corrective measures, no hard starts occurred in eighteen later Aerobee flights in 1964. Author

N67-17821*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TECHNIQUE FOR VERIFYING STRUCTURAL INTEGRITY OF FULL-SCALE SEGMENTS OF LAUNCH VEHICLES AT TRANSONIC SPEEDS
Bernard J. Blaha Washington, NASA, Feb. 1967 17 p refs
(NASA-TN-D-3876) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Wind-tunnel tests of the aeroelastic characteristics of the full-scale flight components of a launch vehicle were conducted at Mach numbers from 0.55 to 2.0. Because of wind-tunnel blockage limitations, only a segment of the vehicle and a corresponding portion of the nose cone could be used to simulate the vehicle configuration. To determine the validity of this technique, static-pressure and terminal-shock data from the model segment were obtained and compared with data from tunnel tests of complete subscale models of the launch vehicle and with flight data. As expected, deviations from axisymmetric flow characteristics were observed. For example, model blockage effects resulted in static pressures ahead of the weather shield step on the full-scale segment 80 percent higher than those on a complete subscale model at Mach 0.9. A knowledge of the flow deviations, however, led to an alteration in the position of the test segment on the model fixture and thus to a better simulation of flight conditions for one series of configurations. Author

N67-17999*# General Electric Co., Philadelphia, Pa. Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AEROTHERMOELASTIC EFFECTS ON UNMANNED ENTRY VEHICLES FOR MARS Final Engineering Report
E. G. Menkes 25 Oct. 1966 289 p refs
(Contracts NAS7-100; JPL-951312)
(NASA-CR-81648) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Entry vehicles designed for operation in the relatively low density level of the Mars atmosphere are examined for aerothermoelastic problems. These lightly loaded (low mass/cross-sectional area) vehicles tend to be relatively flexible. This characteristic, coupled with the deceleration loads, separated hot gas flow, oscillatory body motion, and thermal gradients in the shield raises the specter of aerothermoelastic problems. The specific phenomena investigated include flutter, buffeting forced vibration, acoustics, and static aeroelasticity. The results indicate no severe aerothermoelastic problems exist for the families of Mars entry vehicles investigated. This finding can be traced back to the fact that very low dynamic pressures exist for Mars entry so that there is negligible energy available in the airstream to excite the various aeroelastic phenomena. Author

N67-18024*# Aeronutronic, Newport Beach, Calif.
EFFECTS OF IMPINGEMENT OF ROCKET EXHAUST GASES AND SOLID PARTICLES ON A SPACECRAFT Interim Report, Mar. 18–Oct. 25, 1966
C. H. Lewis, R. D. Hackett, and W. C. Kuby 22 Nov. 1966 41 p refs
(Contracts NAS7-100; JPL-951246)
(NASA-CR-81687) CFSTI: HC $3.00/MF $0.65 CSCL 22B

In experiments conducted to determine impingement damage effects, a helium gas flow facility and a hydrogen–oxygen rocket motor were used to accelerate micron sized Al_2O_3 particles to velocities ranging from 4000 ft/sec to over 10,000 ft/sec. These high speed particles impinged on instrumented target samples. Preliminary analysis indicates that for both data, where the total amount of particles are small, the variation of damage with particle velocity follows the functional form of Sorenson's correlation; there also appears to be little correlation between damage and material type. The damage from micron sized particles is found to be from 100 to 1000 times less than that due to an equivalent volume of large particles. Results also show that particle heating can be significant. Methods of evaluating gaseous plume impingement effects are discussed, with attention centered on highly underexpanded plums and regions in which there are no plume shocks such as the lip shock. M.G.J.

N67-18043* Volt Technical Corp., Washington, D. C.
LUNA-13 IS ON THE MOON [LUNA-13—NA LUNE]
4 Jan. 1967 18 p Transl. into ENGLISH from RUSSIAN
(Contract NAS5-12487)
(NASA-CR-81705; ST-PR-LPS-10545) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This paper summarizes the various communiques relative to the soft landing on the Moon of the new automatic lunar station (ALS) LUNA-13. The first photographs transmitted are presented herewith in their order of publication. Except for the direct study of the solidity and constitution of the lunar surface layer by driving a rod into its surface on command, and of which the devices and procedures are described in detail, the performance of LUNA-13 is in every way analogous to that of LUNA-9. It corroborates the earlier findings concerning the absence on the Moon of a dust layer. The data on the structure of the ground lead to the same conclusions of those of LUNA-9 and SURVEYOR-1. Author

N67-18145*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SECOND UNITED STATES MANNED THREE-PASS ORBITAL MISSION (MERCURY–ATLAS 7, SPACECRAFT 18). DESCRIPTION AND PERFORMANCE ANALYSIS
John H. Boynton, ed. Washington, NASA, Feb. 1967 206 p refs
(NASA-TN-D-3814) CFSTI: HC$3.00/MF$0.65 CSCL 22B

The results and analysis of the second United States manned orbital flight accomplished on May 24, 1962, as a phase of Project Mercury are presented. Spacecraft and launch vehicle descriptions, mission operations, and postflight analyses are included. Particular treatment is given to the investigations of spacecraft systems performance and the aeromedical analyses of the astronaut. Author

N67-18162*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA BOOK FOR ENVIRONMENTAL TESTING AND SPACECRAFT EVALUATION, VOLUME 1
[1965] 291 p refs
(NASA-TM-X-59346) CFSTI: HC$3.00/MF$0.65 CSCL 22B

This up-to-date reference book contains data for environmental testing and spacecraft evaluation with emphasis on the Goddard satellite and NASA launch vehicle and sounding rocket programs. Summarized are scientific and engineering data on space and launch environments and test programs. Appendices consist of an international log of space launches, as well as a glossary on common space terms and definitions applying to environmental test and evaluation procedures. G.G.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-16773*# Technidyne, Inc., West Chester, Pa.
DEVELOPMENT OF AN ENERGY DISSIPATION SYSTEM BASED ON METAL EXTRUSION
Herbert Kartluke and Philip G. Luckhardt Nov. 1966 107 p refs
(Contract NASw-1185)
(NASA-CR-81317) CFSTI: HC$3.00/MF$0.65 CSCL 20K

An energy dissipation system based upon the inverse extrusion process was developed, with aluminum billets serving as the working medium. The resulting shock strut, a tabular telescoping mechanism, was evolved by comparative evaluation of deceleration profile characteristics experienced in absorbing the kinetic energy of a falling body. Suitable shock strut designs utilizing aluminum billets of about 1.5 cubic inches were tested at impact velocities up to 40 feet per second with dropped weights exceeding 400 pounds. It was found that deceleration levels not exceeding 20 g's were within the system capability. Further development could result in even further decreases in deceleration levels. In a given system, the deceleration level varies inversely with the dropped weight and is essentially independent of impact velocity. The best system consistently exceeded 60,000 foot-pounds of energy absorbed per pound of aluminum actually expended. Shock strut design involves a trade-off between the acceptable peak "g" level, the overall length, and the energy absorption efficiency. Author

N67-16779# Illinois Univ., Urbana.
THE ANALYSIS OF SHALLOW SHELL STRUCTURES BY A DISCRETE ELEMENT SYSTEM
B. Mohraz and W. C. Schnobrich Mar. 1966 89 p refs *Its* Structural Res. Ser. No. 304
(Grant NSF GK-538)
(PB-169656) CFSTI: HC$3.00/MF$0.65

The discrete model can be used to analyze a variety of shallow shells. The model gives good estimates of the magnitude and the distribution of deflections and stresses in shells with different edge conditions, different types of loading, and the different values of Poisson's ratio. The comparisons of results indicate that the model can be used to study the behavior of shells of different Gaussian curvatures. Rapid variations in forces and moments through the shell can be predicted by the model, however, for better results larger number of spacings should be used. In general, the obta are sufficiently accurate for design purposes. Author (NSA)

N67-16881# Library of Congress, Washington, D. C. Aerospace Technology Div.
EXPERIMENTAL DETERMINATION OF THE STIFFNESS OF RUBBERIZED-CLOTH MEMBRANES
V. P. Temny *In its* Pure Fluid Devices 29 Aug. 1966 p 217–221 refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), No. 11, 1956 p 1042–1045 (See N67-16861 07-03)

The paper examines the variation in the stiffness of elastic membranes made of rubberized cloth when the initial load or pressure acting upon them is varied. In designing such membranes, which are utilized in various automatic control units, this variation in stiffness attains a considerable magnitude. Author

N67-16887# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
EXPERIMENTAL AND THEORETICAL STUDIES ON BUCKLING OF CONICAL AND CYLINDRICAL SHELLS UNDER COMBINED LOADING Final Report
Josef Singer, Avraham Berkovits, Tanchum Weller, Ori Ishai, Menahem Baruch et al Jun. 1966 156 p refs
(Grant AF-EOAR-63-56)
(TAE-48; AFOSR-66-2589; AD-641971) CFSTI: HC $3.00/MF $0.65

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2. MECHANICAL PROPERTIES OF MYLAR POLYESTER AND THE BUCKLING OF MYLAR CONICAL SHELLS O. Ishai, T. Weller, and J. Singer p 30–48 (See N67-16889 07-32)

3. GENERAL INSTABILITY OF STIFFENED CYLINDRICAL SHELLS UNDER COMBINED AXIAL COMPRESSION AND EXTERNAL OR INTERNAL PRESSURE J. Singer, M. Baruch, and O. Harari p 49–54 (See N67-16890 07-32)

4. OPTIMIZATION OF CONICAL SHELLS WITH NON-UNIFORMLY SPACED RINGS M. Baruch, J. Singer, and O. Harari p 55–67 (See N67-16891 07-32)

5. EXPERIMENTAL STUDIES ON BUCKLING OF STIFFENED CONICAL SHELLS UNDER TORSION AND AXIAL COMPRESSION J. Singer and T. Weller p 68–81 refs (See N67-16892 07-32)

N67-16888# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
BUCKLING OF UNSTIFFENED CONICAL SHELLS UNDER COMBINED LOADING AND AXIAL COMPRESSION, TORSION, AND EXTERNAL OR INTERNAL PRESSURE
Avraham Berkovits, Josef Singer, and Tanchum Weller *In its* Exptl. and Theoret. Studies on Buckling of Conical and Cylindrical Shells Under Combined Loading Jun. 1966 p 1–29 (See N67-16887 07-32) CFSTI: HC$3.00/MF$0.65

Results of an experimental program on the instability of unstiffened aluminum alloy conical shells under combinations of three loadings, axial compression, torsion, and external or internal pressure are presented. Theoretical interaction curves for buckling have been obtained by extension of the linear theory solutions of two-load problems. It is concluded that for the range of pressures investigated, the interaction curve for compression-torsion-pressure loading is defined by direct superposition of compression-pressure, torsion-pressure, and compression-torsion behavior. It is also noted that improvements in experimental technique permitted many repeated buckling tests on the same metal specimen without noticeable damage. A.G.O.

N67-16889# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
MECHANICAL PROPERTIES OF MYLAR POLYESTER AND THE BUCKLING OF MYLAR CONICAL SHELLS
Ori Ishai, Tanchum Weller, and Josef Singer *In its* Exptl. and Theoret. Studies on Buckling of Conical and Cylindrical Shells Under Combined Loading Jun. 1966 p 30–48 (See N67-16887 07-32) CFSTI: HC $3.00/MF $0.65

Mylar A conical shells were tested under the combined loading of axial compression, pressure, and torsion in order to examine the influence of anisotropy in Mylar buckling behavior. Results of mechanical property tests revealed considerable anisotropy that casts some doubt on the reliability of results obtained with Mylar specimens. Comparison of Mylar interaction curves with those obtained with aluminum shells of the same taper ratios also demonstrates the peculiar buckling behavior of Mylar shells. A.G.O.

N67-16890# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
GENERAL INSTABILITY OF STIFFENED CYLINDRICAL SHELLS UNDER COMBINED AXIAL COMPRESSION AND EXTERNAL OR INTERNAL PRESSURE
Josef Singer, Menahem Baruch, and Ovadia Harari *In its* Exptl. and Theoret. Studies on Buckling of Conical and Cylindrical Shells under Combined Loading Jun. 1966 p 49–54 (See N67-16887 07-32) CFSTI: HC $3.00/MF $0.65

Linear Donnell type equations are employed to study the general instability behavior of stiffened shells under combined loads. Computations have been carried out for many typical shells covering a wide range of shell and stiffener geometries. Consideration is given to design implications for launch vehicle or missile mission applications. A.G.O.

N67-16891# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
OPTIMIZATION OF CONICAL SHELLS WITH NON-UNIFORMLY SPACED RINGS
Menahem Baruch, Josef Singer, and Ovadia Harari *In its* Exptl. and Theoret. Studies on Buckling of Conical and Cylindrical Shells under Combined Loading Jun. 1966 p 55–67 (See N67-16887 07-32) CFSTI: HC $3.00/MF $0.65

The optimum configurations of conical shells with uniformly and nonuniformly spaced rings of rectangular cross section are studied and compared. It is concluded that the variation of stiffener spacing in stiffened conical shells yields an improvement in structural efficiency. An additional general conclusion from these studies was that a decrease in the overall stiffness of the structure shifts the minimum weight design point to a smaller number of rings, which allows a larger practical realization of weight savings. A.G.O.

N67-16892# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
EXPERIMENTAL STUDIES ON BUCKLING OF STIFFENED CONICAL SHELLS UNDER TORSION AND AXIAL COMPRESSION
Josef Singer and Tanchum Weller *In its* Exptl. and Theoret. Studies on Buckling of Conical and Cylindrical Shells Under Combined Loading Jun. 1966 p 68–81 refs (See N67-16887 07-32) CFSTI: HC $3.00/MF $0.65

Tests on integrally machined steel specimens under torsion, axial compression, and combined torsion and axial compression are discussed and compared with theory. In the experiments, the onset of buckling and the complete buckling of the whole shell were recorded. It is reported that buckling tests of ring stiffened conical shells under torsion yielded fairly good agreement with linear theory. Under axial compression, good agreement with linear theory was found for shells with closely spaced heavy rings, while for shells with weaker stiffening the agreement was poor. An empirical interaction curve for ring stiffened conical shells under torsion and axial compression was obtained. A.G.O.

N67-16904*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER-IV STRUCTURAL DAMPERS
Peter T. Lyman *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 37–50 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65
(Contract NAS7-100)

Structural dampers employed on the Mariner IV spacecraft were constructed of spring-centered struts consisting of two concentric tubes whose annulus was filled with a very viscous silicone fluid. From early testing throughout the spacecraft development program these dampers performed without difficulty. Since there were no telemetry measurements which yielded direct performance of the spacecraft structure, satisfactory flight performance by the dampers is inferred from the proper functioning of all Mariner IV subsystems. Author

N67-16906*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
NONCONTAMINATING SEPARATION SYSTEMS FOR SPACECRAFT (PROJECT ZIP)
Audley B. Leaman *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 61–71 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

The object of the ZIP program has been to investigate the design and feasibility of explosive separation with the goal of achieving a contaminant-free system. Various joint sections have been included in the study: self-ejecting, low shock, high temperature, multiple attachment, and others. Material studies have been performed to investigate the physical, temperature, and dynamic properties of various elastomers and to select the most promising candidates for utilization. The results of these studies have established the feasibility of the ZIP system. However, the design of a separation for a specific application will normally be a custom design based on the requirements of the specific boost vehicle and the spacecraft. Author

N67-16907*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A VIBRATION ISOLATION MOUNT
Robert E. Reed, Jr. *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 73–79 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

An isolation mount for low frequency excitation in the neighborhood of 1 cps is described. It provides a near-zero spring constant for virtually any length stroke while avoiding electronic servo systems; however, it is limited to applications in an atmospheric environment. Since the atmospheric pressure is relatively constant, the mount can support only a specified weight. Preliminary tests indicate the need for symmetrical diaphragms, and for further

study on ways to support the weight so as to avoid unstable motion. M.G.J.

N67-16912*# Santa Clara Univ., Calif.
ANALYSIS OF AEROSPACE IMPACT PROBLEMS
D. Hayes, C. Cawood, and T. Kertesz *In its* Aerospace Mech. 20 May 1966 p 123–136 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

A graphical technique for analyzing the behavior of objects during and after impact is illustrated by the presentation and experimental verification of an analysis of a particular system. Single impacts with various initial conditions are examined. The analysis is then extended to cover the case of repeated impacts of the same objects. Degeneration of system motion to either a pure central or a pure sliding impact mode is confirmed by both theoretical and experimental results. The existence of a critical angle, which determines the degenerate mode, is established. Author

N67-16913*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
COMPRESSION-SPRING SEPARATION MECHANISMS
T. G. Harrington *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 145–156 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

The use of compression-spring mechanisms in the separation of spacecraft and shrouds is discussed. Guidelines are laid down whereby the separation restraints can be used to determine the necessity, or lack thereof, of closely guiding the spring. Experience (design, analysis, and flight) is cited to show what can be accomplished by proper design of the mechanisms. Author

N67-16917*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-IMPACT-RESISTANT MECHANISMS
James L. Adams *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 181–188 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

Investigations indicated that a large variety of complex and efficient spacecraft mechanisms can be built to survive impacts on the order of 10,000 g from several hundred fps. Problems associated with ruggedizing such mechanisms are discussed, and a variety of related design techniques and methods are presented. Several specific mechanisms designed to survive a range of shock environments are described. Results from investigations conducted by other organizations confirm the conclusions arising from the studies. Author

N67-16918*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A PYROTECHNIC SHOCK ISOLATION MECHANISM
A. L. Ikola *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 189–202 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

The detonation of explosives in pyrotechnic devices produces several sources of shock excitation. This shock, which may be considered as measurable and unmeasurable excitation, can cause equipment failures. Solution of a pyrotechnic shock problem therefore calls for consideration of testing, analysis, equipment modification, and shock isolation. A shock mount that has proved simple to use and extremely effective in protecting equipment is discussed in relation to problems generally present when using shock mounts. Test results demonstrating the performance of the shock mount are also presented. Author

N67-16920*# University of Southern Calif., Los Angeles.
COMPRESSION SPRINGS AT ELEVATED TEMPERATURES
M. J. Siegel *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 223–237 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

The behavior of compression springs is affected by increased temperatures. The most significant factors affecting springs are a loss of load and length (relaxation), and a change in the modulus of rigidity. Relaxation will reduce preset loads or change the location of supported components whereas a change in the modulus of rigidity will alter the spring rate. Both factors must be taken into account when designing compression springs. Curves and equations are presented (for music wire, 18-8 stainless steel, 17-7 PH, and Inconel-X) which can aid in the design of compression springs for use at elevated temperatures. Author

N67-16923*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A CONCEPT FOR THE DESIGN OF VARIABLE-VISCOSITY, VARIABLE-STIFFNESS DAMPERS
Jerome J. Lohr *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 263–275 refs (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

A design concept for damping mechanisms is discussed which permits an order-of-magnitude increase in damping efficiency compared with that of existing dampers. The concept utilizes polymeric materials at temperatures in the region of their glass transition temperatures. In this region (which may extend over a bandwidth of 10° to 50°C or more), configurational rearrangements of the polymer chain backbones allow very high mechanical energy absorption. Both free- and forced-vibration systems were used to study the properties of mechanical systems employing such dampers. Author

N67-16926*# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
DEVELOPMENT OF A PASSIVE DAMPER FOR A GRAVITY-GRADIENT STABILIZED SPACECRAFT
E. J. Buerger *In* Santa Clara Univ. Aerospace Mech. 20 May 1966 p 297–309 (See N67-16901 07-30) CFSTI: HC $3.00/MF $0.65

The configuration of a component that combines two forms of magnetic, passive damping is described: an eddy-current damper, and a hysteresis damper. These dampers are so constructed that either one may be engaged, and the other disengaged, upon command. These dampers and the auxiliary components for switching, a unique angle indicator, and a caging device (used during the launch environment) are housed within a single envelope designated as the combination passive damper. Author

N67-16929# California Univ., Berkeley. Div. of Applied Mechanics.
SIMPLE FORCE MULTIPOLES IN THE THEORY OF DEFORMABLE SURFACES
M. M. Balaban, A. E. Green, and P. M. Naghdi Jul. 1966 49 p refs
(Contract Nonr-222(69))
(AM-66-8; AD-642130) CFSTI: HC $3.00/MF $0.65

The paper is concerned with a nonlinear theory of simple force multipoles for a deformable surface, embedded in a Euclidean 3-space; the surface is not necessarily elastic. The theory is developed with the use of basic thermodynamical principles, together with invariance conditions under superposed rigid body motions. For simplicity, the basic kinematical ingredients are restricted to be the (ordinary) monopolar velocity of the surface and suitable first and second order gradients of the velocity. The theory of an elastic surface and other special cases of the general theory which bear on the foundations of the classical theory of shells are also discussed. Author (TAB)

N67-16959# Air Force Systems Command, Wright-Patterson AFB, Ohio. Strength and Dynamics Branch.

USE OF TUNED VISCOELASTIC DAMPERS FOR REDUCTION OF VIBRATIONS IN AEROSPACE STRUCTURES

David I. G. Jones, John P. Henderson, and George H. Bruns *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 45 p refs (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

The severe vibration levels encountered in modern aerospace vehicles as a result of the intense noise levels generated by rocket and jet engines frequently results in fatigue damage and equipment malfunction. Both the material and configuration aspects of this problem have been investigated and the main effort concentrated on the tuned viscoelastic damper. It is shown that the unique properties of several presently available viscoelastic materials have made it possible to design prototype tuned dampers which are not confined to operation at a single discrete frequency, but can operate over a band of frequencies. Analyses and experiments are briefly described which demonstrate the effectiveness of these prototype tuned dampers in simple structures and in more complex structures typical of aerospace applications. Author

N67-16960# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.

DEVELOPMENT OF ADVANCED COMPOSITE STRUCTURES

Progress Report

Loris D. Whipple *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. I 1966 20 p (See N67-16941 07-34) CFSTI: HC $3.00/MF $0.65

In this paper, the high potential payoffs of using high modulus filament reinforced composite materials in aerospace systems applications are discussed in light of Program Definition Phase studies and technical results of the Air Force Advanced Filaments and Composites Advanced Development Program efforts. The first step taken toward realizing these payoffs by demonstration with actual hardware was the initiation of structural and propulsion component development programs in the areas of aircraft structures, helicopter rotor blades, re-entry vehicles, and gas turbine engines. The results of these seven-month, first generation programs are discussed with emphasis on the analysis of the performance of the structure components. This graphically reflects the status of the entire technological development program. Author

N67-17015# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.

ON STRESS WAVES IN VISCOELASTIC MEDIA CONDUCTING HEAT

J. D. Achenbach, S. M. Vogel, and G. Herrmann Aug. 1966 25 p refs Presented at the IUTAM Symp. on Irreversible Aspects of Continuum Mech., Vienna, Jun. 1966

(Contract Nonr-1228(34))

(TR-66-5; AD-641133) CFSTI: HC $3.00/MF $0.65

The theory of propagating surfaces of discontinuity is used to study one-dimensional stress waves in viscoelastic media which conduct heat. The constitutive laws for stress and entropy are derived from the specific free energy which is taken in the form of a functional expansion to the second order in strain and to the third order in temperature change. With the aid of these laws, relations are developed between the kinematical, mechanical and thermodynamical quantities at the wave front. Explicit expressions are established for both the velocity and the change of magnitude of the stress discontinuity as it propagates through the medium. The results include the effects of viscous damping, temperature-dependent material properties and thermomechanical coupling. Author (TAB)

N67-17031# Naval Ordnance Lab., White Oak, Md.

UNSTEADY TWO DIMENSIONAL FLOWS

Robert Piacesi *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 6 p refs (See N67-17021 07-12) CFSTI: HC $3.00/MF $0.65

Discussed are various methods to calculate the two-dimensional unsteady flow associated with meteoric impact on a spacecraft that propagates a shock wave into both the particle and the target and thus raises the materials to a high-pressure state. As a result, projectile and target materials are ejected from the target medium causing a hemispherical cavity to be formed if the target is thick enough to prevent perforation. Described are: (1) a two-dimensional particle-in-cell hydrodynamic code that used an Eulerian grid for fluid distribution; (2) a viscoelastic model that utilized a particle-in-cell code for the numerical solutions of the equations; (3) a late-stage-equivalence theory using the particle-in-cell code to compare late times pressure fields for projectiles of the same material but different sizes; (4) and also calculations made with a two-dimensional Lagrangian code to account for the elastic-plastic flow. G.G.

N67-17032# Naval Ordnance Lab., White Oak, Md.

WATER ENTRY

W. E. Parr *In its* Theoret. Inviscid Fluid Mech. 26 Sep. 1966 4 p (See N67-17021 07-12 CFSTI: HC $3.00/MF $0.65

The physical problem of water entry is analyzed by considering mathematically the forces, moments, and pressures acting upon a body during its initial impact with the water surface. A mathematical model is formed by assuming that : (1) the water is non-viscous; (2) the surface tension is negligible; (3) the water is incompressible; (4) the air density is negligible; (5) the air–water interface is at constant pressure; (6) the entering body is rigid; and (7) the trajectory of the entering body is described. The problem is solved by presenting the potential due to a distribution of sources and sinks on the rigid boundary surface and on the free surface. Thus, with only boundary points requiring any calculation, the number of space variables in the problem is reduced by one; the full three-dimensional case then comes within the range of present computers. Results obtained by this source sheet method show good qualitative agreement between the shape of the experimental free surface and the calculated one. G.G.

N67-17037# Allied Research Associates, Inc., Concord, Mass.

STRUCTURAL GUIDELINES FOR MATERIALS DEVELOPMENT. PART I: SOME VEHICLE PERFORMANCE AND DESIGN GENERALIZATIONS Final Report, 23 Jun. 1965–22 Oct. 1966

George Gerard Oct. 1966 27 p refs

(Contract NOw-65-0595-f)

(ARA-304-6, Pt.-1; AD-640986) CFSTI: HC $3.00/MF $0.65

Starting with the generalization that the function of a vehicle is to efficiently transport a given payload a given distance, the structural weight fraction has been identified as the factor most sensitive to structures and materials improvement. Furthermore, the value of structural weight saving over the life of the vehicle can be large and thus relatively large costs can be expended in such endeavors. Analysis of the factors comprising the structural weight fraction has lead to the important generalization that the structural design of the vehicle or its major components are characterized by rather narrow ranges of the maximum design index. It is this factor which dictates the specific improvements in materials (or structures) that can result in a meaningful reduction of the structural weight fraction. Author (TAB)

N67-17040# Allied Research Associates, Inc., Concord, Mass.
STRUCTURAL GUIDELINES FOR MATERIALS DEVELOPMENT. PART II: MECHANICAL PROPERTIES AND EFFICIENCY PARAMETERS FOR SHEET MATERIALS Final Report, 23 Jun. 1965–22 Oct. 1966
Peter E. Kyle Oct. 1966 53 p refs
(Contract NOw-65-0595-f)
(ARA-304-6, Pt.-2; AD-640992) CFSTI: HC $3.00/MF $0.65

A catalog is given of materials properties and efficiency parameters for light alloys, hi strength steels and heat resisting alloys. Author (TAB)

N67-17100# Lockheed Missiles and Space Co., Sunnyvale, Calif.
VIBRATIONS OF A PLATE (WING) WITH CAVITIES FILLED WITH A MOVING FLUID
Zh. K. Makhortykh [1966] 4 p refs Transl. into ENGLISH from Mekh. Tverdogo Tel (USSR), no. 5, 1966 p 154–156

The problem of determining the natural vibrations frequencies of an elastic plate with cavities completely filled with an ideal incompressible moving fluid is considered herein. A dependence is obtained between natural vibrations frequencies of the plate and the velocity of fluid motion, and critical values of the fluid flow velocity are obtained. Author

N67-17126 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DETERMINATION OF THE PARAMETERS OF A MECHANICAL ANALOG FOR AXISYMMETRIC VIBRATIONS OF AN ELASTIC CYLINDRICAL VESSEL WITH FLUID
A. A. Pozhalostin 1966 4 p refs Transl. into ENGLISH from Mekh. Tverdogo Tel (Moscow), no. 5, 1966 p 157–159

Forced, small axisymmetric vibrations of an elastic right circular cylinder with an elastic bottom in the shape of a shallow spherical shell filled with a heavy ideal fluid are considered. The vibrations were caused by harmonic motion of the supporting ring. It is shown that the reactive force of the oscillating fluid, which acts on the supporting ring, may be replaced by the reaction of a system of an infinite number of parallel oscillators. The sum of the masses of all the oscillators equals the physical mass of the fluid in the vessel, which is very important in the analysis of dynamical systems of which a composite part is a vessel with a fluid. The velocity potential of the fluid particles was determined under the condition that the fluid is incompressible and that there are no wave motions on the free surface. Gravity was considered to be zero, and the shell inertia was not taken into account. Author

N67-17137 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOLUTION OF STRUCTURAL MECHANICS PROBLEMS BY THE PARTIAL RESPONSES METHOD (PRM)
V. S. Chuvikovskii, O. M. Palii, and V. E. Spiro Jul. 1966 13 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 7, Jul. 1966 p 15–21

A numerical solution, based on the method of successive reduction of elements of mechanical systems to inertialess elastic constraints, is proposed for solving one-dimensional boundary value problems of the structural mechanics of shipbuilding. The crux of the method is stated to be that the solution of the one-dimensional boundary value problem is represented in terms of some system of functions describing the intrinsic properties of the system in their set. These functions are called partial responses. The development of the method is discussed, and extensive examples of its application are given. The method is also recommended for the investigation of other linear and nonlinear boundary problems in the case of one-dimensional mechanical and nonmechanical systems. L.E.W.

N67-17172*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRESS INTENSITY FACTORS FOR CRACKLINE-LOADED EDGE-CRACK SPECIMENS
John E. Srawley and Bernard Gross Washington, NASA, Feb. 1967 21 p refs
(NASA-TN-D-3820) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Stress intensity factors were determined for a variety of specimens, all with straight boundaries, by boundary collocation of the Williams form of stress function. The boundary conditions were determined with the aid of another stress function. The results presented are considered to be comprehensive enough for a wide variety of applications of these specimens. Two complementary types of semifinite crackline-loaded specimen are treated in detail. The results for these specimens can be used graphically to obtain a useful preliminary estimate of the results for any finite specimen with straight boundaries. Boundary collocation analysis need then be conducted only on those cases which appear to be of most practical interest. The boundary collocation results were used to calculate values of the stress intensity coefficient $KBW^{1/2}/P$ for a crackline-loaded specimen of nonlinear contour. These values are in excellent agreement with the published experimental compliance data for this specimen configuration. Author

N67-17194# California Univ., Berkeley. Div. of Applied Mechanics.
SOME RESULTS ON FINITE AMPLITUDE ELASTIC WAVES
M. M. Carroll Jul. 1966 33 p refs
(Contract Nonr-222(69))
(AM-66-9; AD-642131) CFSTI: HC $3.00/MF $0.65

Some special types of finite amplitude wave motions are considered, for which kinematical non-linearities do not arise in the equations of motion of an elastic solid. Consequently, only constitutive non-linearities occur and, for special classes of materials, solutions may be read off from corresponding solutions in the linear theory. These include SH-waves and Love waves in layered or inhomogeneous media. Finite amplitude transverse circularly-polarized harmonic progressive waves are shown to propagate in any compressible or incompressible isotropic elastic material. Some effects of homogeneous pre-stress are also investigated. Author (TAB)

N67-17269# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
BENDING OF CIRCULAR PLATES CONFINING AN INCOMPRESSIBLE LIQUID
Arnold D. Kerr Aug. 1966 15 p refs
(CRREL-RR-187; AD-640887)

Frozen potholes subjected to lateral loads suggest the study of the effect of the confined incompressible liquid upon the behavior of the covering ice plate. Since, for loads of short duration, no creep is expected, the plate may be assumed to behave elastically. The method of solution is described and two examples are treated in detail. A comparison of numerical results shows the strong effect of the confined incompressible liquid upon the deflections and stresses of the plate. Author (TAB)

N67-17372# National Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
FATIGUE TESTS WITH RANDOM AND PROGRAMMED LOAD SEQUENCES WITH AND WITHOUT GROUND-TO-AIR CYCLES. A COMPARATIVE STUDY ON FULL-SCALE WING CENTER SECTIONS

J. Schijve, D. Broek, P. de Rijk, A. Nederveen, and P. J. Sevenhuysen Dec. 1965 55 p refs
(NRL-TR-S.613) CFSTI: HC$3.00/MF$0.65

Results of random, program and supplementary constant-amplitude tests on a 7075-T6 wing structure are presented. Aspects studied are fatigue lives, crack propagation, indication of fatigue critical components, scatter, residual strength, inspection method. Damage calculations are made. Problems concerning assessment of load magnitudes and sequences in full-scale tests are analyzed. Author

N67-17389*# National Aeronautics and Space Administration, Washington, D. C.
APPROXIMATE METHOD FOR THE DETERMINATION OF THE NATURAL OSCILLATION FREQUENCIES OF CYLINDRICAL, CONIC AND TOROIDAL SHELLS [PRIBLIZHENNYY METOD OPREDELENIYA CHASTOT SOBSTVENNYKH KOLEBANIY TSILINDRICHESKIKH, KONICHESKIKH I TOROIDAL'NYKH OBOLOCHEK]
I. I. Meyerovich Nov. 1966 33 p refs Transl. into ENGLISH from the book "Prochnost' i Dinamika Aviatsionnykh Dvigateley" Moscow, Izd. Mashinostr., 1965 p 148–172
(NASA-TT-F-10377) CFSTI: HC$3.00/MF$0.65 CSCL 20K

Development of a method for the approximate determination of the flexural vibrations of shells of revolution, where the vibrations involve the appearance of modal lines along the generatrix and in the meridional directions. The method is based on the use of a Ritz-type strain-energy approach and the selection of the approximating functions such that—besides the boundary conditions—they satisfy the additional conditions of the absence of fluctuations of circumferential strains and stresses and the absence of shear in the middle surface. A detailed analysis is given of the frequency spectrum of a cylindrical shell with arbitrary boundary conditions and of the combined oscillations of two cylindrical shells of different rigidity. These, and the results obtained for a closed thin-walled toroidal shell suspended in free space, are compared with the experiment. Author

N67-17431# Battelle Memorial Inst., Columbus, Ohio.
STRESSES AT NOZZLES IN SPHERICAL SHELLS LOADED WITH PRESSURE, MOMENT OR THRUST Phase Report No. 2
E. C. Rodabaugh, F. J. Witt (Oak Ridge Natl. Lab.), and R. L. Cloud (Bettis Atomic Power Lab., Pittsburgh, Pa.) 15 Jul. 1966 224 p refs
(Contract W-7405-ENG-92)
(TID-23343) CFSTI: HC$3.00/MF$0.65

To evaluate internal and external pressures at nozzles in pressure vessels, 4 "two-piece" shell theories were compared: Bijlaard—moment or thrust loadings; Waters—internal pressure; Leckie–Penny—internal pressure, moment of thrust loadings; and Kalnins—internal pressure, moment or thrust loadings. The basis of each of these theories is discussed. Within the range of dimensional parameters covered, it was found that Bijlaard, Leckie–Penny and Kalnins theories give essentially the same results. Waters theory gives different results than Leckie–Penny or Kalnins theories; the reasons for these differences are considered and numerical comparisons are given. "Multi-piece" shell theories used (in the form of computer programs) were those of Kalnins and Seal–Shell-2. The development of these two programs is discussed, along with numerical comparisons: Kalnins theory is based on thin-shell assumptions; Seal–Shell-2 is more applicable to thick shells and, in general, agrees better with test data than Kalnins. A computer program entitled "BASIC," which uses point matching for axisymmetric bodies of revolution subjected to axisymmetric forces, is discussed and the results for an example are shown. Author (NSA)

N67-17519*# Aerojet-General Corp., Sacramento, Calif.
STRESS-WAVE DETECTION SATURN S-II Final Report, 17 Jan.–30 Nov. 1966
A. T. Green Dec. 1966 86 p refs
(Contract NAS8-20263)
(NASA-CR-61161) CFSTI: HC$3.00/MF$0.65 CSCL 22D

The ability to sense and record stress-waves, the elastic-waves transmitted from flaw growth, in a Saturn S-II propellant tank bulkhead was demonstrated during a proof-pressure hydrotest. The stress-wave data was used in triangulation techniques to describe the origin of the wave. Tensile specimen tests confirmed that flaw growth in 2014-T6 aluminum alloy procedes incrementally and that the relationship between stress-wave emission and flaw extension can be developed in order to provide an assessment of flaw criticality and structural reliability. Author

N67-17562# Battelle Memorial Inst., Columbus, Ohio.
FLEXIBILITY OF NOZZLES IN SPHERICAL SHELLS Phase Report No. 3
E. C. Rodabaugh and T. J. Atterbury 28 Jun. 1966 32 p refs
(Contract W-7405-ENG-92)
(TID-23344) CFSTI: HC$3.00/MF$0.65

Design graphs are presented by means of which the flexibility can be determined for nozzles in spherical heads, or in heads which are locally spherical in the vicinity of the nozzle. Graphs are applicable for $10 \leq D/T \leq 250$, $d/D \leq 0.5$, and $t/T \leq 3.0$. Both the nozzle and sphere are assumed to have constant wall thickness in the vicinity of the nozzle and nozzle protrudes externally only. Graphs for flexibility are given for both moment and thrust loadings applied to the nozzles. The significance of the flexibility of nozzles in heads, as a part of a piping system, is illustrated by calculation of forces and moments in a number of simple piping systems with the usual assumption of the nozzle as an anchor and with the nozzle flexibility included. For this particular set of examples, the ratio $(M_n)_0/(M_n)_X$ ranges from 2.5 to 6, i.e., the moment at the nozzle is overestimated by factors of 2.5 to 6 by using the anchor assumption. These examples were selected to show where the nozzle flexibility factor can be significant; in many piping systems the effect of the nozzle flexibility will be insignificant. Author (NSA)

N67-17659# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
THERMAL STRESSES IN AN ABLATING THICK-WALLED SPHERE
Fred P. Avril, Richard F. Parisse, and S. V. Nardo Oct. 1966 40 p refs
(Contract Nonr-839(23))
(PIBAL-930; AD-643881) CFSTI: HC$3.00/MF$0.65

A theoretical technique for predicting thermal stresses in a thick-walled ablating sphere of a low-conductivity material subjected to point-symmetric aerodynamic thermal and pressure loading is proposed. A previously developed approximate ablation analysis is combined with a known thermal stress solution for multi-layer spheres in order to determine stresses and strains in a material with variable modulus of elasticity and coefficient of linear thermal expansion. The multi-layer analysis is compared with a known thermoelastic solution for the incompressible sphere as a qualitative measure of the accuracy of this approach. The thermoelastic strains predicted are compared to the results of hypersonic wind tunnel strain measurements obtained on tests of ten Plexiglas and Nylon hemispherical models. For four of the models the agreement is good, while agreement for the other six models ranges from fair to poor. TAB

N67-17680# Pacific Applied Research, Los Angeles, Calif.
FABRICATION OF STRUCTURAL SPECIMENS FOR THE INVESTIGATION OF PEAK PRESSURE AND MULTI-MODE EFFECTS OF SONIC FATIGUE Final Report, Apr. 1965–Mar. 1966
Donald E. Hines Wright-Patterson AFB, Ohio. AFSC, Jul. 1966 85 p refs
(Contract AF 33(615)-2377)
(PAR-2D; AFFDL-TD-66-42; AD-642490) CFSTI: HC $3.00/MF $0.65

The report describes the analysis, design and fabrication of structural specimens to be used in an investigation of peak pressure and multi-mode effects of sonic fatigue. These specimens are to be fatigue tested to failure. Details of the analysis and design are presented for three-bay panels and frame stringer panels. The three-bay panels were designed to fatigue in 100,000 cycles when exposed to an SPL of 162 db. A linear structural response approach is used, and the possibility of nonlinearities is examined. The frame stringer panels were designed to withstand various combinations of internal bursting pressures and external aerodynamic loads. Procedures used in fabricating the above specimens, and specimens designed by R and D personnel are also described. Author (TAB)

N67-17708# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
TRANSFER OF LOAD FROM AN EDGE-STIFFENER TO A SHEET—A RECONSIDERATION OF MELAN'S PROBLEM
Rokuro Muki and Eli Sternberg Sep. 1966 37 p refs
(Contract Nonr-220(58))
(TR-7; AD-641497) CFSTI: HC $3.00/MF $0.65

The problem posed by the diffusion of load from an infinite edge-stiffener into a semi-infinite elastic sheet is reconsidered under two alternative refinements of the underlying stiffener model. First, the stiffener is regarded as an elastic strip of finite width and the theory of generalized plane stress is applied rigorously to the sheet and stiffener alike. Next, Melan's one-dimensional treatment of the stiffener is amended to account for its bending rigidity. The 'exact' and the intermediate approximate solution thus obtained are compared to Melan's results with particular attention to the relevant asymptotic behavior in the vicinity of the applied load and at large distances from the load. Comparative numerical results, showing the variation of the sheet stresses at the interface and the distribution of the axial stiffener force, are included. Author (TAB)

N67-17713# Midwest Research Inst., Kansas City, Mo.
A THEORETICAL INVESTIGATION ON THE AEROELASTIC STABILITY OF ISOTROPIC CYLINDRICAL SHELLS AT BOTH THE HIGH AND LOW SUPERSONIC MACH NUMBERS Final Technical Report
Larry Carter and Ronald Stearman Oct. 1966 78 p refs
(Contract AF 49(638)-1639)
(AFOSR-66-1930; AD-642129) CFSTI: HC $3.00/MF $0.65

The study includes an investigation on the aeroelastic stability of thin isotropic cylindrical shells over the Mach number range 1.2 to 3. The analysis coupled the Donnell shell equations with a linear piston theory to approximate the aerodynamic forces at the high supersonic Mach numbers while a slender body theory was used to approximate the aerodynamic forces at the low supersonic Mach numbers. The influence of the shells structural boundary conditions and initial stresses on its aeroelastic stability was also investigated. This included a study of the shell stability around both its deformed and undeformed state, the deformed state being due to the initial stresses in the shell. The theoretical results were finally compared with recent experimental studies conducted at both the high and low supersonic Mach numbers. Author (TAB)

N67-17731# Argonne National Lab., Ill.
DEFORMATION ANALYSIS OF A CIRCULAR COUPLED-PLATE STRUCTURE
H. Halle Mar. 1966 27 p refs
(Contract W-31-109-ENG-38)
(ANL-7145) CFSTI: HC $3.00/MF $0.65

A structure consisting of two circular, parallel plates, interconnected by a grid work of equally spaced members, subjected to normal axisymmetric loading, is analyzed for its overall deformation behavior. Approximate equations presented for the evaluation of deflections and stresses are shown to be sufficiently accurate for engineering estimates and permit examination of the relative influence of the various plate and grid parameters on the deformation behavior of the structure. Model tests provided verification of the analysis. The analytical method is essentially based on the superposing of two deformation components which account for the bending of the plates, when the connecting grid members are considered to be ideally rigid, and the additional effects resulting from the actual deformation of these members. These two components represent bending of the plates about a common intermediate neutral axis, and about their individual internal neutral axes, respectively. The analytical and experimental study was also extended to coupled-beam structures. Author (NSA)

N67-17752# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REFINED SOLUTION OF THE PROBLEM OF THE BENDING OF A FLEXIBLE SQUARE PLATE WITH HINGE-SUPPORTED EDGES UNDER THE ACTION OF NORMAL PRESSURE
G. V. Zakirov 18 Aug. 1966 9 p ref Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), no. 1, 1959 p 28–31
(FTD-TT-65-2020; AD-643999) CFSTI: HC $3.00/MF $0.65

Consideration is given to a hinge-supported square plate with a uniformly distributed normal load q. The edges of the plate remain rectilinear at the time of the deformation, their approach during the bending being restricted by elastic rods (cross bracing). The problem is solved by the Bubnov-Galerkin method. Author (TAB)

N67-17777*# Southern Illinois Univ., Carbondale. School of Technology.
STRUCTURAL DESIGN CONCEPTS—TECHNICAL BRIEF
[1966] 9 p
(Grant NsG-607)
(NASA-CR-70408) CFSTI: HC $3.00/MF $0.65 CSCL 13M

A concept of element-face rotation-translation transformation of polyhedral forms is presented as a structural design concept. Ideas regarding subsurface supported structural columns for lunar application are advocated through use of a tubular column fabricated from low density ductile material. Insertion into the lunar surface is achieved by an explosive charge enclosed within the tube or by a root-like system filled with a resin-activator mixture which could be forced into the soil. Consideration is also given to a self-generated truncated cone used for planetary structures. S.P.

N67-17830*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A METHOD OF ESTIMATING HIGH TEMPERATURE LOW CYCLE FATIGUE BEHAVIOR OF MATERIALS
S. S. Manson and Gary Halford Washington, NASA, 1967 28 p refs To be Presented at the Symp. on Thermal and High Strain Fatigue, London, Jun. 1967 Sponsored by Inst. of Metals
(NASA-TM-X-52270) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A method is described whereby static tensile and creep-rupture properties can be used to estimate lower bound, average, and upper bound low cycle fatigue behavior in the creep range. The

method is based primarily on the method of universal slopes previously developed for estimating room temperature fatigue behavior, and in part on a highly simplified creep-rupture–fatigue analysis. Reasonable agreement is obtained when the estimates are compared with total strain range-life data for numerous engineering alloys. Included in the study are coated and uncoated nickel-base alloys, a cobalt-base alloy, low and high alloy steels, and stainless steels tested under laboratory conditions over a wide range of temperatures and cyclic rates. Author

N67-17844# Royal Aircraft Establishment, Farnborough (England).
A METHOD OF FATIGUE LIFE PREDICTION USING DATA OBTAINED UNDER RANDOM LOADING CONDITIONS
I. T. Kirkby and P. R. Edwards Jan. 1966 46 p refs
(RAE-TR-66023; AD-642978) CFSTI: HC $3.00/MF $0.65

Preliminary tests were made to investigate a method of fatigue life prediction in which fatigue data obtained under a simple form of random loading are substituted for the data hitherto obtained under sinusoidal test conditions. The results of this work show a significant increase in the accuracy of prediction, but it is evident that further allowance for load interaction effects is necessary, if greater accuracy is to be obtained. Author (TAB)

N67-17849# Southampton Univ. (England). Inst. of Sound and Vibration Research.
[SOUND AND VIBRATION RESEARCH] Annual Report, Period Ending Jun. 1966
Jun. 1966 129 p refs
CFSTI: HC $3.00/MF $0.65

New posts, both industrially and university sponsored, and including lectureships and research fellowships, have been created. A third M. Sc. and Diploma course, on Environmental and Human Factors in Engineering, has been added and a new B. Sc. (Eng.) course which the Institute is conducting on behalf of the Faculty of Engineering was opened. With the aid of a five-year grant from the Medical Research Council, a co-ordinated clinical, physiological and physical research program was established. Other funds encouraged the establishment of a new research team for investigations of problems of noise, vibration and fatigue in nuclear power plant heat exchangers. First investigations in the field of architectural acoustics have begun. Two laboratories for fan noise and diesel engine noise work were planned for 1966. ESRO

N67-17864# Aeronautical Research Council (Gt. Brit.)
STRESS CONCENTRATION FACTORS FOR ROUNDED RECTANGULAR HOLES IN INFINITE SHEETS
A. J. Sobey London, HMSO, 1965 18 p refs Supersedes RAE-Struct-292; ARC-25629; see X64-14146
(ARC-R&M-3407; RAE-STRUCT-292; ARC-25629) CFSTI: HC $3.00/MF $0.65

An approximate hole mapping method was applied to a family of rounded rectangular holes in sheets subjected to biaxial stress or shear. Stress profiles were obtained using 40-term mapping functions, and the perturbation error was smoothed out in the stress distributions. Graphs are presented for the stress under the various loading conditions and hole sizes. It is concluded that the peak stress for any hole of this type may be interpolated from the charts. N.E.N.

N67-17878*# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
THE BUCKLING OF CYLINDRICAL SHELLS Status Report No. 10
E. E. Sechler Jan. 1966 16 p refs
(Grant NsG-18-59)
(NASA-CR-70121) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A series of tests on the buckling of electroformed cylindrical shells under uniform axial compression with a local initial imperfection is reported. The imperfection consisted of a circular area positioned half way between the ends of the shell. The largest imperfections tested were of the order of the size of the buckled wave form. In addition to the imperfection tests on the electroformed shells, some tests were carried out using shells formed from Mylar. Three testing machines are considered with respect to their influence on the buckling load. Other areas discussed are buckling of conical shells, stability of cylindrical shells under axisymmetric moving loads, dynamic buckling of thin shells, and buckling of cylindrical shells with random imperfections. S.P.

N67-17991*# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
COMPLEX TREATMENT OF A CLASS OF NONCONSERVATIVE STABILITY PROBLEMS
S. N. Prasad and G. Herrmann Jan. 1967 27 p refs
(Grant NsG-605)
(NASA-CR-81672; TR-67-1) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This study is concerned with certain aspects of the theory of stability of continuous, one-dimensional, nonconservative elastic systems. In particular, it is pointed out that several types of such systems may be described analytically by the same non-self-adjoint boundary value problem involving a complex differential equation of motion. The imaginary part of the complex force parameter is of interest because it may be associated with a destabilizing effect, the loss of stability being due primarily to the real part of the complex force. The physical origin of the imaginary part may be associated with velocity-dependent forces (such as viscous damping, Coriolis acceleration and other gyroscopic forces), and certain other forces which need not be velocity-dependent, e.g., a torque which remains in the plane of deformation of a cantilevered bar. Several general theorems applicable to the class of systems selected for study are established and an example serves to illustrate various features of this class. Author

N67-18027* General Dynamics/Convair, San Diego, Calif.
CENTAUR 4d STRUCTURAL TEST PITCH AXIS BENDING MOMENT EID 55-7545-1 MODEL 55
J. S. Steibel 16 Jun. 1965 145 p refs
(Contract NAS3-3232)
(NASA-CR-81696; Rept.-55B-3309-4) CFSTI: $3.00 CSCL 22D

Tests were conducted to demonstrate the structural integrity of the Centaur vehicle (AC-6 configuration) Station 210 and Station 412 structural interfaces when subjected to limit and ultimate design loads producing bending moments about the pitch (X–X) axis. Other objectives were to establish the optimum setting for the nose fairing jettison hinge gap, and to record the load transfer to the tank mounted hinge fittings during structural loading of the test vehicle. Results indicate that the objectives were achieved, and the vehicle withstood the limit and ultimate design loads. Load transfer to the jettison hinge did not exceed allowable values. Author

N67-18030*# Allied Research Associates, Inc., Concord, Mass.
MINIMUM WEIGHT DESIGN ASPECTS OF STIFFENED CYLINDERS UNDER COMPRESSION
C. Lakshmikantham and H. Becker 9 Jan. 1967 11 p refs
(Contract NASw-1378)
(NASA-CR-81693; ARA-326-5) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The influence of stiffener eccentricity and location is considered in relation to minimum weight design aspects of stiffened cylinders. The stability modes of a typical grid stiffening system of

rectangular section are identified as a local instability of the stiffener flanges; a local instability of a panel included by a pair of stringers and a pair of rings; and the general instability of the entire cylinder inclusive of rings and stringers. The theory of general instability of deep-stiffened cylinders is developed, the main assumptions of the theory are given, and equations are derived for the stress–strain relationship, the strain–displacement relationship, and equilibrium of the shell element. Tabulated data are presented to show that, in general, the outside stiffeners increase the load carrying capacity of the cylinder, compared to the inside stiffeners. The problems of minimum weight design are outlined, and the efficiencies of symmetrical and asymmetrical designs are compared. M.G.J.

N67-18035*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
TRANSMISSION OF SOUND AND VIBRATION TO A SHROUD-ENCLOSED SPACECRAFT
Jerome E. Manning, Richard H. Lyon, and Terry D. Sharton 15 Oct. 1966 183 p refs
(Contract NAS5-9601)
(NASA-CR-81688; Rept.-1431) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An analytical approach toward predicting the flow of vibratory energy to a shroud-enclosed spacecraft is presented. In the approach, two paths of energy flow are considered: first, the acoustical path along which energy flows from the external exciting field through the shroud and interior acoustic space to the spacecraft; and second, the mechanical path along which energy flows from the external field through the shroud and spacecraft mounting-trusses to the spacecraft. Theoretically predicted response levels in octave frequency bands for a model of the OGO spacecraft assembly are presented. These predictions show that the spacecraft response to energy transmitted along the acoustic path is a factor of 10 to 100 greater than the response due to energy transmitted along the mechanical path over the frequency range 250 to 8000 Hz. Author

N67-18096# California Univ., Berkeley. Structural Engineering Lab.
A COMPUTER PROGRAM FOR THE STATIC AND DYNAMIC FINITE ELEMENT ANALYSIS OF AXISYMMETRIC THIN SHELLS
H. Y. Chow, Z. A. Lu, J. F. Abel, E. P. Popov, and J. Penzien Oct. 1966 145 p refs
(Grant NsG-274)
(NASA-CR-81739; SESM-66-18) CFSTI: $3.00 CSCL 20K

A Fortran IV listing and a flow chart of a computer program for the static and dynamic small deflection analysis of axisymmetric thin shells of revolution is presented. The program permits free and forced vibration investigation as well as static analysis. Although the program is not completely general as far as shell geometry and boundary conditions are concerned, enough theoretical information is presented to enable a potential user to assemble a program general enough for his particular needs. Theoretical bases for various aspects of the problem, and useful formulas are given. Author

N67-18097* California Univ., Berkeley. Structural Engineering Lab.
COMPUTER PROGRAMS FOR BENDING ANALYSIS OF ELASTIC PLASTIC CIRCULAR PLATES
S. Yaghmai M. Khojasteh-Bakht, and E. P. Popov Nov. 1966 60 p refs
(Grant NsG-274)
(NASA-CR-81741; SESM-66-19) CFSTI: $3.00 CSCL 20K

A description of computer programs for the bending analysis of the elastic–plastic circular plates with arbitrary axisymmetric loading and support condition is presented. Complete listings of the main routines together with the concise flow charts of the programs are included. The programs are prepared for IBM 7094 digital computer. Both single precision and double precision Fortran IV language have been employed. An example is presented to aid in the application of the programs. Author

N67-18110# Aeronautical Research Council (Gt. Brit.)
THE BUCKLING OF AN AXIALLY LOADED CIRCULAR CYLINDER WITH INITIAL IMPERFECTIONS
A. J. Sobey London, HMSO, 1966 32 p refs Supersedes RAE-TR-64016; ARC-26557; see X65-13277
(ARC-R&M-3430; RAE-TR-64016; ARC-26557) CFSTI: HC $3.00/MF $0.65

An extension of the Donnell and Wan analysis for the buckling of a shell with initial imperfections is presented for a mode of arbitrary profile. Results for a mode with 26 arbitrary parameters are given by charts of the stress-strain characteristics for cylinders with initial displacements of between one-eighth and five times the skin thickness of the cylinder. A direct optimization of the energy function is used. Almroth's minimum post-buckled stress for the ideal cylinder (0.0656 Et/R) is lowered to 0.0518 Et/R, and a critical assessment of the value of such figures provided. Author

N67-18149*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
MATRIX ANALYSIS OF LONGITUDINAL AND TORSIONAL VIBRATIONS IN NONUNIFORM MULTIBRANCH BEAMS
Robert T. Wingate Washington, NASA, Feb. 1967 51 p refs
(NASA-TN-D-3844) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Since longitudinal modes and frequencies provide basic data for dynamic analyses of arbitrary beam-like structures and since closed-form solutions for the modes are generally not feasible to obtain, an approximate method is developed for computing the natural frequencies and the corresponding mode shapes for a variable-section, unconstrained multibranch beam. A lumped mass analogy employing influence coefficients is used to represent the beam. The simultaneous equations of motion for the lumped mass system are derived in matrix form and algebraically manipulated to yield a classical eigenvalue equation solvable by standard procedures. The orthogonality relationship of the natural modes is derived and used to form the basis of an orthogonal sweeping process for determination of modes above the fundamental. Numerical examples including an application to a solid-fuel launch system are presented. Also, a detailed discussion is devoted to the theoretical verifications of the approximate modes and frequencies. Author

N67-18153*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
DEFORMATION OF SHALLOW SPHERICAL SANDWICH SHELLS UNDER LOCAL LOADING
John N. Rossettos Washington, NASA, Feb. 1967 48 p refs
(NASA-TN-D-3855) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Analytical solutions are obtained for the small symmetrical deformation of sandwich caps under both uniform and ring-type local loading with various types of edge support. The governing equations, which include transverse shear deformation, are reduced to a single complex second-order differential equation. The solution is obtained in terms of Kelvin functions and a parameter which measures the shear flexibility of the sandwich core. Explicit formulas for calculating the stresses and displacements at all points in the cap were obtained. Results indicate that for localized loading, where the radius of the local load is one-tenth of the shell edge radius or less, transverse shear deformation plays an important role over a wide range of sandwich core stiffness. In general, the stresses and displacements for uniform localized loading are greater than those for a corresponding ring load and depend on the loading area. For all cases where the edge of the cap is clamped

and/or restrained against radial expansion, the maximum lateral deflection at the center of the cap varies by at most 20 percent, depending on the precise edge condition. The deflections for these cases, however, differ substantially (by 60 to 100 percent) from the deflection for the case where the edge is both simply supported and unrestrained against radial expansion. Author

N67-18183# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON NONSTATIONARY FORCED VIBRATIONS OF CYLINDRICAL SHELLS
L. A. Movsisian [1963] 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), v. 16, no. 2, 1963 p 3–12

The problem of forced vibrations of orthotropic circular cylindrical shells is solved for the case when the frequency of the perturbing force is a linear function of time. A method is used in which an indefinite integral for a linear elastic system with one degree of freedom is reduced to known tabulated functions, taking into account the damping of vibrations in the material. The energy dissipation in the material during vibration is taken into account on the basis of the Voght hypothesis. C.T.C.

N67-18185# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON NONLINEAR RESONANCE
I. Ia. Viner 30 Oct. 1965 2 p refs

An asymptotic method is applied to an investigation of the stability of forced vibrations described by a second order nonlinear differential equation. C.T.C.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-16722*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
STUDY OF EQUILIBRIUM AIR TOTAL RADIATION
J. S. Gruszczynski and W. R. Warren, Jr. 1966 51 p refs
(Contract NASw-939)
(NASA-CR-81315) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Results are presented from a study of high temperature air radiance applicable to superorbital reentry vehicles. Consideration is given to equilibrium radiation in air and gas mixtures assumed to represent the atmospheres of the near planets. Several theoretical approaches to the problem are reviewed and compared. A shock tube experiment has shown that an electrically driven conventional tube is capable of producing useful model stagnation region test flows to the 60,000 ft/sec flight velocity simulation level. Experimental gas radiance data, obtained in the vicinity of a simulated 38,000 ft/sec flight velocity, show that there is a significant contribution to intensity in the vacuum ultraviolet portion of the spectrum. Also, there appears to be a contribution to intensity in the wavelength region between the quartz and LiF cut-off values. A.G.O.

N67-16963# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
CONFRONTING THE HEAT PROTECTION PROBLEM IN HYPERSONIC NOZZLES USING HIGH-ENTHALPY AIR
Gordon M. Gray *In its* Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 41 p refs (See N67-16962 07-34)
CFSTI: HC $3.00/MF $0.65

The process characteristics involved in producing hypersonic flow with high enthalpy air are examined to identify the major factors which bear upon the design of the nozzle. High pressure, high heat flux and high oxidation potential of the gas stream emerge as the critical elements for consideration. The combined effect of these three characteristics is shown to restrict the usable cooling techniques when provision is made for adequate gas stream containment. Current studies and experimentation with film cooling; and self-contained throat protection methods are described. Material properties and system behavior are analyzed. The constant profile ablators are identified for their significant potential in throat cooling. In addition, an economic comparison is made among available and future throat protection techniques and Mach 13 is shown to be the approximate limit for true-flight-environment testing in large blow-down facilities. Author

N67-17188# Technische Univ., Berlin (West Germany). Institut fuer Kerntechnik.
REPORT ON RESEARCH WORK, 1963–1965 [BERICHT UEBER FORSCHUNGSARBEITEN, 1963–1965]
Mar. 1966 95 p refs In GERMAN; ENGLISH summary Submitted for publication
(TUBIK-1) CFSTI: HC $3.00/MF $0.65

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N67-17189# Technische Univ., Berlin (West Germany). Institut fuer Kerntechnik.
WAVY STRUCTURE AND MASS TRANSFER OF THE WAVY FALLING FILM [WELLENSTRUKTUR UND STOFFUEBERRANG BEIM WELLIGEN RIESELFILM]
Werner Malewski *In its* Report on Res., 1963–1965 Mar. 1966 p 16–33 refs In GERMAN; ENGLISH summary Submitted for Publication (See N67-17188 07-33) CFSTI: HC $3.00/MF $0.65

It is shown, how surface ripples and mass transfer in pseudolaminar falling films are correlated. The mass transfer behavior at a wavy surface can be completely described, if the wave structure is fully developed. The newly defined quantities, viz., average number of waves per unit of length and mixing intensity, are adequate to characterize the structure of a wavy film. They become additional expressions for the mass transfer equations which are valid for falling films with smooth surface. The calculation of wetted wall columns for mass transfer is described. Author (NSA)

N67-17190# Technische Univ., Berlin (West Germany). Institut fuer Kerntechnik.
GEOMETRY, FLOW FRICTION, AND THERMAL INVESTIGATIONS OF WIRE GAUZES [GEOMETRISCHE, STROEMUNGSTECHNISCHE UND THERMISCHE UNTERSUCHUNGEN]

K. H. Baumann, E. Blass, and W. Schmidt-Pathmann *In its* Report on Res., 1963–1965 Mar. 1966 p 34–72 refs In GERMAN; ENGLISH summary Submitted for Publication (See N67-17188 07-33) CFSTI: HC$3.00/MF$0.65

An investigation of the geometric, flow friction and heat transfer characteristics of wire gauzes is described. Traditional plain wire gauzes of different design, size, and material are tested. Porosity and specific surface are suited for the correlation of flow friction and heat transfer data. Equations or nomograms are developed for the calculation of these parameters from simple geometric informations such as wire diameter, mesh number, and gauze thickness. The flow friction data of wire gauzes in air stream can satisfactorily be represented by physically reasonable equations. Previously published results of thermal investigations are correlated by dimensionless groups. The numerous complications which affect the determination of heat transfer coefficients are submitted. It was found out that especially the complex phenomena of conductivity plays an important role in the overall characteristics and will have to be examined in more detail. Author (NSA)

N67-17191# Technische Univ., Berlin (West Germany). Institut fuer Kerntechnik.

OPTIMIZING THE COOLING OF LIQUID-METAL PUMPS WORKING AT HIGH TEMPERATURES [OPTIMIERUNG DER KUEHLUNG FLUESSIGMETALLPUMPEN FUER HOHE TEMPERATUREN]

Ulfried Wesser *In its* Report on Res., 1963–1965 Mar. 1966 p 73–92 refs In GERMAN; ENGLISH summary Submitted for Publication (See N67-17188 07-33) CFSTI: HC $3.00/MF $0.65

A cooling system for electromagnetic pumps is described. Fluid-temperatures above 1000°C are allowed without remarkable decrease of pump efficiency. Monograms are given to determinate maximal yoke-temperature in dependence of various parameters. The design of an optimal cooling system by a graphical method is shown. Author (NSA)

N67-17218# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering.

COMBUSTION KINETICS OF TETRAFLUOROETHYLENE Final Technical Report

Richard A. Matula Sep. 1966 18 p refs
(Grant AF-AFOSR-981-65)
(AFOSR-66-2336; AD-640830) CFSTI: HC$3.00/MF$0.65

An experimental facility for the study of high temperature-kinetics in the C/F/O reaction system was designed and constructed. Apparatus for the production of high purity tetrafluoroethylene and carbonyl fluoride is described. The reaction vessel design, gas analysis system, furnace, and temperature measurement and control systems are also described. A discussion of the various solid support-stationary phase combinations tested for the gas chromatographic separation of the compounds; N2, O2, F2, CO, CO2, COF2, CF4, C2F4, C2F6, C3F6 and C3F8 is included. It is concluded that Flurolube and Silicone Oil DC-FS-1265 are the most promising stationary phases for the required analysis. It is also noted that activated silica gel is useful for the analysis. Finally the capabilities of a Fortran IV thermochemical program which is presently being adapted for the necessary equilibrium computations are described. Author (TAB)

N67-17260# Lehigh Univ., Bethlehem, Pa. Inst. of Research.

MATHEMATICAL AND EXPERIMENTAL INVESTIGATION OF THERMAL INITIATION OF EXPLOSION Progress Report, 1 Apr.–1 Jul. 1966

George R. Jenkins 1 Jul. 1966 4 p
(Contract DA-28-017-AMC-1090(A))
(AD-640145) CFSTI: HC$3.00/MF$0.65

An experimental apparatus for studying thermal initiation of explosions is described with respect to new equipment installations. A sensitive controller for the reaction-zone temperature, and a mechanism to deliver samples of lead azide to the reaction chamber are briefly described. Equipment set up to dry azide samples and store them in a powder in a darkened dessicator is also mentioned. S.P.

N67-17297# Atlantic Research Corp., Alexandria, Va.

SOLID PROPELLANT IGNITION AND RESPONSE OF COMBUSTION TO PRESSURE TRANSIENTS

Guenther von Elbe *In* Md. Univ. Aerospace Eng. 1966 Sep. 1966 p 50–73 refs (See N67-17293 07-34) CFSTI: HC $3.00/MF $0.65

Solid-propellant burning is described in terms of a model that specifies that the propellant grain receives heat by conduction from the adjacent flame or igniting medium, that the heat flux from the flame to the grain surface responds instantly to changes of variables, and that gasification of the propellant material occurs at the grain surface at a critical temperature T_s. The temperature profile at the propellant surface responds to a pressure transient in the sense that for positive dp/dt the term $k\,(d^2T/dx^2)$ is larger than the steady-state value corresponding to any momentarily existing pressure p, and vice versa. In the former case the grain ablates more rapidly than in the steady state at pressure p. In the latter case the grain becomes extinct at a critical rate of pressure decrease. The theoretical development yields substantial numerical agreement with experimental data on propellant extinction and reignition including L^* instability. Furthermore, the pressure regime can be predicted for chuffing and hangfire in rocket ignition. Author

N67-17371# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

RESULTING ERROR OF THE DETERMINATION OF THERMAL FLUX BY THE ANALOG METHOD IN THE CASE OF SUPERFICIAL TEMPERATURES OF THE FORM t^n (WHEN n IS A NON-NEGATIVE INTEGER) [ERREUR RESULTANT DE LA DETERMINATION DES FLUX THERMIQUES PAR LA METHODE ANALOGIQUE DANS LE CAS DE TEMPERATURES SUPERFICIELLES DE LA FORME t^n (n ENTIER, NON NEGATIF)]

André Benoit Oct. 1964 35 p refs In FRENCH
(TN-22) CFSTI: HC$3.00/MF$0.65

The analogical solution to the problem of heat propagation in a one-dimensional, closed domain is considered for a surface temperature which may be represented by a t polynomial. Exact expressions of temperature and thermal flux are obtained for a class of bounds to which pertain the particular cases for perfectly conducting or perfectly isolated bounds. The solutions are compared and the differences written in the best form for an analytical study and a numerical calculation. Transl. by R.Ll.

N67-17383*# National Aeronautics and Space Administration, Washington, D. C.

THE EFFECT OF TRANSFER PROCESSES ON THE STABILITY OF A PLANE FLAME FRONT [O VLIYANII PROTSESSOV PERENOSA NA USTOYCHIVOST' PLOSKOGO FRONTA PLAMENI]

A. G. Istratov and V. B. Librovich Jan. 1967 22 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 30, 1966 p 451–466
(NASA-TT-F-10636) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Derivation of a revised approximate solution, for large but finite Reynolds numbers, to prove the theory of Landau concerning absolute instability of a plane laminar flame front. The solution takes into account the effects of viscosity, diffusion, heat conduction, and variations in the chemical reaction rate on flame front stability.

Corrections to order $1/N_R$ of Landau's solution are determined by the Germain and Guiraud method of studying transfer processes in weakly bent shock waves. Author

N67-17384*# National Aeronautics and Space Administration, Washington, D. C.
INFLUENCE OF THE TYPE OF MOLECULAR COMPOUND ON THE CONCENTRATION OF ATOMS OF MATTER IN AN ALTERNATING CURRENT ARC WITH THE INJECTION OF SAMPLES BY AN AIR BLAST [VLIYANIYE VIDA MOLEKULYARNOGO SOYEDINENIYA NA KONTSENTRATSIYU ATOMOV VESHCHESTVA V DUGE PEREMENNOGO TOKA PRI VVEDENII PROBY METODOM PROSYPKI]
A. V. Milyus Dec. 1966 5 p refs Transl. into ENGLISH from Spektroskopiya, Metody i Primenenie, Akad. Nauk SSSR, Sibirsk. Otd. (Moscow), 1964 p 15–17
(NASA-TT-F-10601) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The method of determining the absolute concentration of atoms and the influence of the molecular composition of the sample on the concentration of nickel atoms in an alternating current arc flame is investigated. The sample is injected with an air blast. Both the degree of ionization and temperature are experimentally determined. The reproducibility of the analysis for atom concentration was 2–4 better using an air blast to introduce the sample than for the usual method of sample introduction. The temperature values, however, were 300–400°C higher with this new method. Various explanatory hypotheses are presented. Author

N67-17434# Maschinenfabrik Augsburg-Nurnberg A. G., Nuremberg (West Germany).
RESEARCH INTO THE CRITICAL HEAT FLUX (BURNOUT) IN BOILING WATER. PULSATING BURNOUT Final Report
F. Mayinger, O. Schad, and E. Weiss Mar. 1966 151 p refs /ts Rept.-09.02.00
(Contract EURATOM-057-61 RDD)
(EURAEC-1620; EUR-2833) CFSTI: HC $3.00/MF $0.65

The physical phenomena in pulsating burnout and its dependency on various thermodynamic, hydrodynamic and geometric parameters as well as the layout of the test loop was investigated in numerous tests covering over 1200 test points. The tests were made on internally cooled round individual tubes of 7 to 15 mm diameter and a length/diameter ratio of the heated section of 5 to 140 and include mass flows from 100 to 400 g/cm^2 sec in a pressure range from 70 to 140 kgf/cm^2. Pulsating burnout can arise only in flows with sub-cooled boiling and with a very low steam quality. By providing for sufficient throttling of the flow at the inlet to the heated channel as well as by eliminating any compressible volumes in the loop between the circulating pump and the heated channel, efficient control of the pulsating burnout can be obtained. Author (NSA)

N67-17443# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
CONDENSATION HEAT TRANSFER AT AN AGITATED, STEAM–WATER INTERFACE
Owen C. Jones, Jr. Jun. 1966 31 p refs Presented at the ASME 1966 Winter Ann. Conf., New York
(Contract W-31-109-ENG-52)
(CONF-661102-1) CFSTI: HC $3.00/MF $0.65

Condensation heat-transfer experiments were conducted for a low-pressure, subsurface jet-agitated, steam–water interface. Nusselt numbers were found to correlate well with the ratio of Grashof number to Reynolds number squared, (Gr/Re^2), based on jet exit depth and overall difference between the steam temperature and the temperature of the entering agitating jet. A critical depth was postulated and shown experimentally to be the limiting jet exit depth beyond which there was no interfacial agitation. A macroscopic analysis, assuming buoyancy to be the governing mechanism, yielded a good graphical correlation. The exponent in the correlation, however, did not accurately describe the trends. Instead, experiments showed, and further analysis verified, that the viscous effects were predominant, giving a linear relationship between the critical depth and the jet exit Reynolds number. Color films of the flow pattern and surface condensation layer were taken with the aid of dye injection. Measurements showed a linear relationship between jet radius and distance above the jet, in agreement with Prandtl mixing-length theory. The constant of proportionality was found to differ markedly from that given by other investigators for a horizontal jet in a semi-infinite medium. The range of parameters covered by the experiment included $5.6\times10^3 \leq Re \leq 1.4\times10^5$, $6.0\times10^7 \; Gr \leq 3.1\times10^{10}$, $4.5 \leq Nu \leq 7.2\times10^2$, and $8.8\times10^{-2} \leq Gr/Re^2 \leq 9.1$. Author (NSA)

N67-17468# Idaho Nuclear Corp., Idaho Falls.
STEADY STATE HEAT CONDUCTION WITH IRREGULAR SHAPED BOUNDARIES
W. A. Scheffler Sep. 1966 10 p ref
(Contract AT(10-1)-1230)
(IN-1027) CFSTI: HC $3.00/MF $0.65

The effect of irregular shaped boundaries on the temperature distribution in a solid is calculated. The method used to calculate the effect of the boundary perturbation is straightforward and of a general nature. The application of such a method to problems in heat conduction will provide temperature corrections to thermocouples due to solid boundary irregularities. Author (NSA)

N67-17505*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
GASEOUS-FILM COOLING OF A ROCKET MOTOR WITH INJECTION NEAR THE THROAT
James G. Lucas and Richard L. Golladay Washington, NASA, Feb. 1967 35 p refs
(NASA-TN-D-3836) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An experimental investigation of gaseous-film cooling of the nozzle of a small JP-4-gaseous-oxygen rocket motor was conducted using tangentially injected nitrogen as the coolant. The following results were obtained: (1) Gaseous-film cooling of a rocket nozzle can be accomplished with coolant injection into the subsonic accelerating flow field with cooling lasting along the full length of the throat and divergent portions of the nozzle; (2) The adiabatic wall temperature distribution downstream of the film-coolant injection slot was correlated to a significant distance beyond the nozzle throat by the Hatch–Papell relation, with hgL (heat-transfer coefficient times engine circumference) used as an integrated average from the coolant injection station to the separate data stations. In addition, both a change in the constant K from 0.04 to 0 and the use of local hot-gas static temperature as the driving temperature T_g were required to achieve apparent correlation of the present data; (3) Over a portion of the coolant flow range with the 0.045-inch slot height, there appears to be anomalous behavior in the downstream adiabatic wall temperature pattern, which suggests a possibility of coolant flow optimization which cannot be determined from the Hatch–Papell relation as it presently exists; and (4) The lip of the tangential coolant injection slot is a critical component due to thermal expansion with resulting distortion and heavy compressive stresses. This item would require very careful design in a flight application to avoid the effects of thermal expansion and to minimize the disturbing effects on coolant flow of both the lip thickness and the lip supports. In a critical application, the use of nontangential coolant injection might therefore be required to eliminate the lip and its problem. Author

N67-17513*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
VACUUM CHAMBER HEAT-TRANSMISSION ANALYSIS
Walter W. Guy and Wilbert E. Ellis Washington, NASA, Feb. 1967 13 p refs
(NASA-TM-X-1355) CFSTI: HC$3.00/MF$0.65 CSCL 20M

An analytical investigation was conducted to study the effect of the test-chamber pressure level on the accuracy of deep-space heat-transfer simulation, using as parameters the test vehicle emittance and surface temperature. The study reveals that, with the exception of extremely low temperature conditions, a test-chamber pressure of approximately 10^{-5} mm Hg provides the best thermal simulation. Author

N67-17538# Los Alamos Scientific Lab., N. Mex.
THERMAL CONDUCTIVITY OF ZTA GRAPHITE
P. Wagner and L. B. Daudsberg [1966] 20 p refs Presented at the 6th Conf. on Thermal Conductivity, Wright-Patterson AFB, Ohio
(Contract W-7405-ENG-36)
(LA-DC-8163; CONF-661013-1) CFSTI: HC$3.00/MF$0.65

Measurements of the thermal conductivity of ZTA graphite in the temperature interval 23°C to 2700°C are reported. Three different methods were used to cover the temperature interval. The conductivity perpendicular to the direction of the applied hot-working force is reported to be k(watt/cm-°C) = 460/T(°K)+0.28 over the entire temperature interval. The thermal conductivity in the parallel direction is discussed. Measurements of linear thermal expansion are reported and changes of dimension which occur during the progress of these measurements are discussed. Author (NSA)

N67-17599# Aerojet-General Nucleonics, San Ramon, Calif.
ALKALI METALS EVALUATION PROGRAM Quarterly Progress Report, 1 Jan.–31 Mar. 1966
P. Y. Achener and E. D. Parr 31 Mar. 1966 28 p refs
(Contract AT(04-3)-368)
(AGN-8187) CFSTI: HC$3.00/MF$0.65

Efforts directed toward determination of Rb and Cs thermodynamic and transport properties for space power systems are reported. Four experimental runs to determine pressure-volume-temperature relations were conducted for Cs and three similar runs were conducted for Rb. Resulting data are included. Data are also presented from Cs viscosity experiments at 55 to 1063°C. Equipment and procedures are being developed to measure specific heats, vapor viscosities and vapor thermal conductivities of Cs and Rb. Preparations for investigations of alkali metals for heat pipe applications are discussed. NSA

N67-17727# California Univ., Berkeley. Lawrence Radiation Lab.
EXPLOSION TESTS IN A GLOVED BOX WITH ETHER–AIR MIXTURES
Jensen Young and Will D. Phillips 12 Jul. 1965 17 p refs
(Contract W-7405-ENG-48)
(UCRL-16259) CFSTI: HC$3.00/MF$0.65

The explosion tests were conducted to insure that an inert-atmosphere gloved box was safe for the evaporation of ether, to determine the volume of ether that could be evaporated safely in the box, and to test the box under explosive conditions. The tests showed that the nitrogen–ether concentrations were safe under the test conditions. Rapid vaporization of either in air produced local explosive concentrations that were unpredictable and explosions occurred when the hot plate temperatures approached 180°C. The slow evaporation of ether at a low air flow was safe. The lower explosive limit of ether–air mixtures was about 3% by volume in a gloved box of 12 cubic feet. The box withstood many vigorous explosions with the explosive force venting through the gloved ports and out the gasket seal around the window. R.N.A.

N67-17739# Los Alamos Scientific Lab., N. Mex.
THERMAL-ACOUSTIC OSCILLATIONS INDUCED BY FORCED CONVECTION HEATING OF DENSE HYDROGEN
Rodney S. Thurston (Ph.D. Thesis—N. Mex. Univ.) 26 Aug. 1966 159 p refs
(Contract W-7405-ENG-36)
(LA-3543) CFSTI: HC$3.00/MF$0.65

Acoustic frequencies were used as a reference for thermal-acoustic oscillations. An experimental investigation of thermal-acoustic oscillations during forced convection heating of dense hydrogen was made at sub and super-critical pressures between 112 and 265 psia. The experiments were performed on a 1/4 inch ID by 10 foot long electrically heated stainless steel tube between plena. In some cases the tube was heated over its entire length. In other cases only the inlet one-third and only the outlet two-thirds of the tube length were heated. Inlet Reynolds numbers were varied between 35,000 and 900,000. Boiling numbers ranged from 0.00026 to 0.0013. Strouhal numbers ranged from 0.37 to 23. Thermal-acoustic oscillations in pressure, fluid temperature, and volumetric rate of flow were observed. An empirical equation was obtained between the boiling number and specific volume number at the inception of oscillations. The observed frequencies were related to acoustic frequencies of Helmholtz and open–open pipe resonance. The observed frequencies were between 4 and 38 cps for the Helmholtz mode, and between 50 and 150 cps for the first harmonic of the pipe mode. The ratio of observed to acoustic frequencies were correlated versus Strouhal number. At Strouhal numbers greater than 2.0 the ratio was one. The maximum peak to peak pressure amplitude was 60 psi. The maximum peak to peak temperature amplitude of the hydrogen was 138°R. The amplitudes of pressure oscillations were correlated by an amplitude number as a function of a boiling number minus the inception boiling number. Author (NSA)

N67-17808# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID FLAMES. PART V: ETHYLENE-RICH FLAMES
G. S. Pearson London, Min. of Aviation, Mar. 1966 33 p refs
(RPE-TR-66/1) CFSTI: HC $3.00/MF $0.65

Burning velocities, temperatures and burnt gas compositions have been measured for ethylene–perchloric acid pre-mixed flames containing from 2 to 24 times as much ethylene as is required for a stoichiometric mixture. Soot formation is observed for a limited range of mixture ratios. When the amount of ethylene exceeds three moles per mole of acid, the excess ethylene does not react but functions as a diluent. The results are compared with those for methane-rich flames and a mechanism is proposed. Author (ESRO)

N67-17809# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID FLAMES. PART VI: ETHANE-RICH FLAMES
G. S. Pearson London, Min. of Aviation, Mar. 1966 27 p refs
(RPE-TR-66/2) CFSTI: HC$3.00/MF$0.65

Burning velocities, temperatures and burnt gas compositions were measured for ethane–perchloric acid premixed flames containing from 2 to 17 times as much ethane as is required for a stoichiometric mixture. Soot formation was observed but only with a limited range of mixture ratios. When the amount of ethane exceeds three to four moles per mole of acid, the excess ethane does not react but functions as a diluent. The observed products are discussed and a mechanism is proposed that is basically similar to that suggested previously for methane-rich flames. The general properties of fuel-rich perchloric acid flames are discussed. Author (TAB)

N67-17924 von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
ANALOG SOLUTION FOR HEAT FLUX USING A TIME DEPENDENT SOURCE TEMPERATURE OF THE FORM $T=at^n$
A. Benoit and J.-M. Chanoine Nov. 1964 55 p refs
(VKI-TN-23) CFSTI: $3.00

The errors resulting in the determination of temperatures and heat fluxes by a finite one-dimensional analog network are computed for the following conditions. The boundary temperature, at the origin, is of the form t^n, where t is the time and n is a non-negative integer, the end of the slab is held at constant temperature or is perfectly insulated. The results for both cases are given in tables and represented graphically for values of n ranging from zero to ten. Author

N67-17948*# Avco Corp., Wilmington, Mass. Missiles, Space and Electronics Group.
AN EXPERIMENTAL COMPARISON OF THREE TYPICAL MARS ENTRY BODY SHAPES ON THE BASIS OF TOTAL EQUILIBRIUM SHOCK-LAYER RADIATION
H. B. Dyner and W. G. Reinecke 10 Oct. 1966 110 p refs
(Contracts NAS7-100; JPL-951331)
(NASA-CR-81675; AVSSD-0228-66-RR) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An approximate comparison was made of the total equilibrium shock-layer radiation for three potential Martian entry body shapes at 0-, 45-, and 90-degrees angles-of-attack. This assessment was performed by conducting radiation measurements in a shock tube, and shock shape measurements in a shock tunnel. Using these data, radiation results were extrapolated to a trajectory condition for the full-size vehicles using a simplified analytical model. The efficacy of the extrapolation method was tested by comparing the zero angle-of-attack extrapolated results of the shock tube to the radiation measurements obtained in ballistic range experiments (which simulated the true entry conditions except for size) and to theory. Agreement was satisfactory for the blunt cone and Apollo shapes; however, no comparison could be made for the tension shell. Local radiation distribution measurements were performed in the shock tube for a blunt 60-degree half-angle cone, using a model instrumented with fiber optics. The effect of pressure on the total equilibrium radiation was determined over a limited range for the blunt cone at zero angle-of-attack. Author

N67-17962*# Denver Research Inst., Colo.
BUBBLE GROWTH PARAMETERS IN SATURATED AND SUBCOOLED NUCLEATE BOILING Final Report
Thomas R. Rehm and C. W. Chiang 12 Jan. 1967 56 p refs
(Grant NGR-06-004-035)
(NASA-CR-81673; DRI-863-6701.1) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An analysis of sample bubbles generated in the conventional type of boiling equipment with three different liquids: water, and water solution of 'sucrose' and 'propanol,' was conducted. The bubble histories for the 'sucrose' and 'propanol' solutions are compared to the bubble histories for water to demonstrate the effect of surface tension and viscosity on bubble behavior. Also conducted was an analysis of a single bubble individually generated by the use of a laser beam on a tiny thermocouple or a thin flat plate submerged in water. The feasibility of this laser beam method is shown, and it is noted that the sphericity of a single bubble is reasonably good. A.G.O.

N67-17996*# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
THEORETICAL STUDY OF RADIANT HEAT EXCHANGE FOR NON-GRAY NON-DIFFUSE SURFACES IN A SPACE ENVIRONMENT Final Report
R. G. Hering Sep. 1966 78 p refs
(Grant NGR-14-005-036)
(NASA-CR-81653; ME-TN-036-1) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The effect of the spectral and directional radiation property dependencies of typical spacecraft structural materials on radiant heat exchange and equilibrium temperatures in a space environment is examined. A method of analysis for evaluating radiant heat transfer between non-gray non-diffuse surfaces is given. The relationship of the widely used gray theories of radiant transfer to the real surface analysis is discussed. The detailed surface property information needed for the non-diffuse non-gray analysis is embodied in the bi-directional reflectance of the participating surfaces. Two models for bi-directional reflectance of metal surfaces and directional and hemispherical surface radiation properties are reviewed. Although heat transfer results are not available for the non-gray non-diffuse surface analysis, intensity distributions for a simplified version of the selected system are given and discussed. Heat transfer and equilibrium temperatures predicted by gray theory are also presented. The results of the research effort and conclusions derived are summarized. R.N.A.

N67-18028*# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
HEAT TRANSFER DURING FILM CONDENSATION OF POTASSIUM VAPOR
Detlev Gustav Kroger (Ph.D. Thesis) [1966] 83 p refs
(Grant NsG-496)
(NASA-CR-81695; DSR-75239-42) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Theoretical and experimental investigations were conducted to determine (1) heat transfer during film condensation of pure saturated potassium vapor on a vertical surface; and (2) heat transfer during film condensation of potassium vapor in the presence of a small quantity of noncondensable gas. Relative to the large discrepancy between theory and experiment for heat transfer during film condensation of pure liquid metal vapors, calculations from kinetic theory and irreversible thermodynamics suggest that this difference may be due to a significant thermal resistance at the liquid–vapor interface in addition to that of the condensate film. This interfacial resistance is noticeable at low vapor pressures and is dependent on a condensation coefficient to be determined experimentally. The presence of a trace of noncondensable gas during condensation may greatly reduce the heat transfer rate. An analysis predicting this is presented, and experiments are performed to test the validity. Author

N67-18090* Southern Illinois Univ., Edwardsville.
SERIES REPRESENTATION OF GENERALIZED TEMPERATURE FUNCTIONS
Deborah Tepper Haimo [1966] 17 p refs Submitted for Publication
(Grant NGR-14-008-009)
(NASA-CR-81746) CFSTI: $3.00 CSCL 20M

Criteria established for the expansion of a solution of the generalized heat equation are shown to be necessary and sufficient for representing the same solution by a Maclaurin series in x^2 and t. Analogous theorems for the ordinary heat equation are derived. The region of convergence of the Maclaurin series was determined. L.S.

N67-18096* Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
STUDY OF HEAT TRANSFER THROUGH CONVECTION LAYERS Final Report
R. J. Goldstein and T. Y. Chu 1966 28 p refs
(Grant NsG-714)
(NASA-CR-81740) CFSTI: $3.00 CSCL 20M

The heat transfer and mean temperature distribution with turbulent free convection in an air layer situated between two aluminum plates, and heated from below with constant non-slip boundaries, were measured by means of Mach–Zehnder interferograms. Studies also concerning onset of flow at low Rayleigh numbers were also made. The onset point of convection was obtained by observing the change of the temperature field as the fluid layer was heated continuously. L.S.

N67-18104* Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics and Engineering Sciences.
STUDY OF RECIRCULATING GAS FLOW FIELDS IN THE BASE REGION OF SATURN-CLASS VEHICLES Quarterly Progress Report, 1 Nov. 1965–31 Jan. 1966
Richard F. Hoglund 31 Jan. 1966 7 p refs
(Contract NAS8-11485)
(NASA-CR-81762) CFSTI: $3.00 CSCL 21B

Characteristic times are compared for the decay of turbulent eddies in the base region of Saturn-type launch vehicles and for the transfer of energy through chemical reactions. Turbulent mixing times are much longer than the reaction times for an energy-releasing reaction in the afterburning region. A reactant element is considered thoroughly mixed with the fluid in the jet core at a point where the large eddies that captured the element at the jet boundary are decayed into the range of molecular diffusion. The turbulent core may be resolved into a component that has not been mixed on a molecular basis with the main flow and maintains its original properties, as well as a homogeneous component that consists of initial jet fluid and that the engulfed fluid produces after the reaction. Any fluid entering the jet will mix and react chemically after a lag time or distance. An axially symmetric flow is considered in which the boundary layer approximations are valid according to the general mixing theory. It is assumed that there is no pressure gradient in the mixing region; and the mathematical model is evolved. M.W.R.

N67-18137*# Brown Univ., Providence, R. I. Div. of Engineering.
VARIATIONAL METHODS FOR SOLVING HEAT CONDUCTION PROBLEMS Semiannual Status Report, 15 Apr.–15 Oct. 1966
15 Oct. 1966 9 p refs
(Grant NGR-40-002-012)
(NASA-CR-81794) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Summary data are presented on heat conduction solutions for the following problems: (1) use of a transcendental approximation in transient conduction with a non-linear boundary condition; (2) combined transient conduction and radiation; (3) transient conduction in a passive probe for measuring adaptive response of human skin heat transfer; and (4) approximation of repeated integrals of the error function. The approximation method for the latter problem is appendixed. R.Ll.

N67-18164*# Case Inst. of Tech., Cleveland, Ohio.
DUAL FUNCTIONS AND HEAT EXPANSIONS
L. R. Bragg (Oakland Univ.) [1966] 8 p refs
(Grant NsG-544)
(NASA-CR-81668) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Conditions were established under which an analytic solution of the radial heat equation $\delta/\delta t\ u(r,t) = \Delta_\mu u(r,t), \Delta_\mu = D_r + [(\mu-1)/r]D_r$ has valid series expansions. The radial heat polynomials and their corresponding Appell transforms were established under the assumption that $\mu > 1$. Results show that $u(r,t)$ has a valid representation in the time strip $/t/ < 1/(4\sigma)$ provided there exists an entire function of growth in r^2. Similarly, $u(r,t)$ has the representation in the half plane $t > \sigma \geq 0$ provided that $u(r,t)$ satisfies a Huygen's principle as well as the integrability condition. G.G.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-16941# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
PROCEEDINGS OF THE THIRTEENTH ANNUAL AIR FORCE SCIENCE AND ENGINEERING SYMPOSIUM, VOLUME I
1966 652 p refs Symp. held at Arnold AF Sta., Tenn., 27–29 Sep. 1966 Sponsored by AFSC and Office of Aerospace Res. Prepared jointly with Tenn. Univ., Tullahoma
(AD-641921) CFSTI: HC $3.00/MF $0.65

Symposium papers on Air Force scientific and engineering programs are presented. For individual titles see N67-16942–N67-16961.

N67-16962# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
PROCEEDINGS OF THE 13TH ANNUAL AIR FORCE SCIENCE AND ENGINEERING SYMPOSIUM, VOLUME II
1966 669 p refs Symp. held at Arnold AF Sta., Tenn., 27–29 Sep. 1966 Sponsored by AFSC and the Office of Aerospace Res. Prepared jointly with Tenn. Univ., Tullahoma
(AD-641922) CFSTI: HC $3.00/MF $0.65

Symposium papers on Air Force scientific and engineering programs are presented. For individual titles see N67-16983–N67-16985.

N67-16976# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A STUDY OF JOB PREFERENCES OF GOVERNMENT AND NON-GOVERNMENT PERSONNEL
Robinette E. McCabe *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 29 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

USAF officers, civil service employees of the San Francisco Bay Area, and employees of a missiles and space company, participated in the research. Government men differed from non-government men on all incentives except advancement. Government males rated pay, type of work, and employer higher than did the non-government men. Contrary to expectations, they assigned a lower value to security and benefits. Hours and working conditions were also seen as less important to government men. Sharp differences were encountered between male and female preferences. Security was given top place in both government and non-government groups of women. Of less importance to the female than to her masculine work-mates are pay, advancement, and working conditions. The incentive which singularly revealed the greatest difference in male and female preferences was type of work. Although males gave it first place, it was of only median concern to the female. The most noticeable changes appeared as a funtion of education. Pay, advancement, and type of work all gained marked importance as the educational level went up. Author

N67-16977# Air Force Logistics Command, Wright-Patterson AFB, Ohio. Operations Analysis Office.
MAXIMIZING PROTECTION FROM EOQ SAFETY LEVELS
Irving Katz and Victor J. Presutti, Jr. *In* AEDC Proc. of the 13th Ann. AF Sci. and Eng. Symp., Vol. II 1966 38 p refs (See N67-16962 07-34) CFSTI: HC $3.00/MF $0.65

In an effort to increase effectiveness without increasing cost, research leading to new formulations of inventory safety

levels for bit and piece items (otherwise known as Economic Order Quantity or EOQ items), at the wholesale depot echelon, was conducted. Various safety level alternatives were tested, using two independently developed large-scale Monte Carlo computer simulation models. This paper treats the results from only one of these models, which was developed in the Operations Analysis Office for use under conditions of random item behavior with unusually high variability. Both simulations demonstrated the superior cost-effectiveness of the new Safety Level formulation proposed by the Operations Analysis Office. The indicated benefits to be derived are very large, including simultaneous improvement in support effectiveness and a reduction in inventory of millions of dollars.
Author

N67-16986# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
PROCEEDINGS OF THE 13th ANNUAL AIR FORCE SCIENCE AND ENGINEERING SYMPOSIUM, VOLUME III
[1966] 339 p refs Symp. held at AEDC, 27–29 Sep. 1966 Sponsored by AFSC and Office of Aerospace Res. Prepared jointly with Tenn. Univ., Tullahoma
(AD-641923) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. OPTIMUM MAGNETS FOR MHD GENERATORS R. R. Barthelemy and C. E. Oberly (Air Force Sys. Command) 24 p refs (See N67-16987 07-11)

2. AUTOMATION IN THE NEW EASTERN TEST RANGE CENTRAL TELEMETRY STATION (TEL-IV) J. L. Gilbert (Air Force Eastern Test Range) 40 p refs (See N67-16988 07-11)

3. CONTROL LOGIC FOR ATTITUDE CONTROL OF A SPACE VEHICLE C. E. Hall and J. J. D'Azzo (Air Force Inst. of Tech.) 38 p refs (See N67-16989 07-10)

4. USAF IMPROVED ALTIMETRY SYSTEMS P. R. Marshall (Air Force Sys. Command) 34 p refs (See N67-16990 07-14)

5. THUNDERSTORM LIGHTNING E. Miller (Aeron. Sys. Div.) 23 p refs (See N67-16991 07-13)

6. BIOASTRONAUTICS LABORATORY RESEARCH TOOL W. L. O'Hern (Air Force Eastern Test Range) 33 p refs (See N67-16992 07-05)

7. THE GEMINI LAUNCH VEHICLE PILOT SAFETY PROGRAM J. A. Schira, Jr. (Air Force Eastern Test Range) 23 p refs (See N67-16993 07-05)

8. SIMULATION OF LOW ALTITUDE CLEAR AIR TURBULENCE FOR AUTOMATIC FLIGHT CONTROL DESIGN N. P. Taylor (Air Force Sys. Command) 39 p refs (See N67-16994 07-11)

9. AN EVALUATION OF THE ACCELEROCARDIOGRAPH AS AN INSTRUMENT FOR MEASUREMENT OF PHYSIOLOGICAL PARAMETERS H. G. Vielhauer (Air Force Sys. Command) 31 p refs (See N67-16995 07-05)

10. ELECTROMAGNETIC PULSE (EMP) GENERATION AND MEASUREMENT G. R. Riling and S. T. Negler (Air Force Special Weapons Center) 31 p refs (See N67-16996 07-23)

N67-17140* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE DATA THESAURUS
Nov. 1966 71 p Reprinted
(NASA-TM-X-59379) CFSTI: HC $3.00/MF $0.65 CSCL 05B

A space data thesaurus is presented to index and retrieve space information, as well as to aid in selection of appropriate terminology. Details are given on the use of the thesaurus, including term selection, phrasing of inquiries, thesaurus conventions (e.g., cross references, scope notes, and alphabetization), and source of thesaurus terminology.
L.E.W.

N67-17195# RAND Corp., Santa Monica, Calif.
A DEEP INDEX OF DERIVATIONAL MORPHOLOGY
Dean S. Worth Sep. 1966 35 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5143-PR; AD-640962) CFSTI: HC $3.00/MF $0.65

The memorandum describes a projected, Deep Index, to the extant literature on Russian derivational morphology. The memorandum describes the type of literature being abstracted, the classification of information into discrete categories for retrieval, the steps taken to prepare data for conversion to machine format, and the transliteration and abbreviation conventions used in the Index. An example of Russian scholarly text is appended, together with the format in which this text appears after processing.
Author (TAB)

N67-17261 Chicago Univ., Ill. Inst. for Computer Research.
ICR QUARTERLY REPORT, NUMBER 9
Richard H. Miller 1 May 1966 96 p refs
(Contract AT(11-1)-614)
(COO-614-45) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. DATA TRANSMISSION BETWEEN THE MANIAC III AND THE IBM 7040 R. M. Herwitt, J. Bounin, and C. K. Teng 3 p (See N67-17262 07-08)

2. THE MAN-MACHINE REPORT C. C. J. Roothaan 3 p (See N67-17263 07-08)

3. μ-CAPTURE PROGRAM K. Laitinen, N. Alton, and J. Klems 7 p (See N67-17264 07-24)

4. HIGH-ENERGY INTER-NUCLEAR CASCADES A. Van Ginneken et al 1 p refs (See N67-17265 07-24)

5. ON THE COVERGENCE OF AN ACCELERATED ITERATIVE METHOD IN THE SOLUTION OF SINGULAR EQUATIONS W. V. Petryshyn 6 p refs (See N67-17266 07-19)

6. FURTHER REMARKS ON NONLINEAR P-COMPACT OPERATORS IN BANACH SPACE W. V. Petryshyn 9 p refs (See N67-17267 07-19)

7. POLARIZATION IN STELLAR DYNAMICAL SYSTEMS R. H. Miller 9 p refs (See N67-17268 07-30)

8. RELAXATION IN A MODEL CLUSTER R. H. Miller 4 p refs (See N67-17269 07-30)

9. SOME COMMENTS ON GILBERT'S ANALYTIC GRAMMAR G. L. Robinson 6 p refs (See N67-17270 07-34)

10. THE PRODUCTION AND STABILIZATION OF REAL-TIME TASK SCHEDULES G. K. Manacher 31 p refs (See N67-17271 07-05)

N67-17270 Chicago Univ., Ill. Inst. for Computer Research.
SOME COMMENTS ON GILBERT'S ANALYTIC GRAMMAR
Charles L. Robinson *In its* ICR Quart. Rept., No. 9 1 May 1966 6 p refs (See N67-17261 07-34) CFSTI: HC $3.00/MF $0.65

An analytic grammar called an expaned analytic grammar is introduced with a new constraint parameter such that, while the additional constraint detracts nothing from the power of the model in general, it allows the grammar to correctly parse an arithmetic expression using the standard production rules. The context free portions of languages such as Algol can be represented in their traditional form. Gilbert's model is evaluated, and the problems it presents are solved by the new parameter constraint.
S.P.

N67-17293# Maryland Univ., College Park. Dept. of Aerospace Engineering.
AEROSPACE ENGINEERING 1966
Joseph A. Schetz, ed. Sep. 1966 158 p refs Proc. of a Conf. held in College Park, Md., 15 Mar. 1966
(Contract AF-AFOSR-1151-66)
(AFOSR-66-1943; AD-641434) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE TENTH MINTA MARTIN LECTURE: APPLICATIONS OF OPTIMAL CONTROL THEORY IN AEROSPACE ENGINEERING A. E. Bryson, Jr. (MIT) p 1–40 refs (See N67-17294 07-34)

2. PLASMAS IN GEOPHYSICS AND ASTROPHYSICS F. S. Singer (Miami Univ.) p 41–45 (See N67-17295 07-25)

3. FLUID CONTROL THEORY J. M. Kirshner (Harry Diamond Labs.) p 46–49 (See N67-17296 07-03)

4. SOLID PROPELLANT IGNITION AND RESPONSE OF COMBUSTION TO PRESSURE TRANSIENTS G. von Elbe (Atlantic Res. Corp.) p 50–73 refs (See N67-17297 07-33)

5. A BRIEF REVIEW OF RESEARCH ON THE IMPINGEMENT OF AXIALLY SYMMETRIC FREE JETS C. duP. Donaldson (Aeron. Res. Assoc. of Princeton) p 74–110 refs (See N67-17298 07-12)

6. CHEMICAL NON-EQUILIBRIUM EFFECTS ON HIGH SPEED FLOW F. K. Hill (APL/JHU) p 111–124 refs (See N67-17299 07-12)

7. A STUDY OF TANGENTIAL SLOT INJECTION IN SUPERSONIC FLOW H. E. Gilreath and J. A. Schetz p 125–152 refs (See N67-17300 07-12)

N67-17850# Swiss Association for Space Technology, Zurich (Switzerland).

[SWISS ACTIVITIES WITHIN EUROPEAN COMMISSIONS AND STUDY GROUPS] Bulletin No. 2

F. Hummler 15 Mar. 1966 37 p refs In GERMAN

CFSTI: HC $3.00/MF $0.65

This bulletin reports on the activities of the following study groups: a) for a Swiss research ground station, b) for patent and contract problems and c) the Technical Planing Staff of the CETS (European Conference on Satellite Communications). Brief mention is made of the possibility of access to the joint ESRO, ELDO and EUROSPACE mechanised documentation retrieval system. Information is also given on Swiss activities within commissions and study groups in the scientific and industrial field. The paper ends with a list of international events. The appendix describes the structure and programs of international organizations (ESRO/CERS, ELDO/CECLES, EUROSPACE, CETS, COSPAR, COMSAT/INTELSAT). ESRO

N67-17861* California Univ., Los Angeles. Div. of Research.

ON ORGANIZATIONAL AGING IN AN R&D FACILITY

William H. McWhinney Jan. 1966 23 p refs *Its* NASA Res. Paper No. 4

(Grant NsG-237)

(NASA-CR-71785) CFSTI: HC $3.00 CSCL 05J

The conditions which produce organizational aging on the context of a particular research and development organization are explored for an operation which has shown at least some of the aging symptoms. Information is utilized to build a theoretical approach and to develop strategies for mitigating the various weaknesses occurring in the aging syndrome. The study is limited to consideration of personnel policies which determine the acquisition, movement within the organization, and separation of employees. Factors considered are the effects of an aging staff, staleness occasioned by familiarity, and the rigidity that is developed to protect the weaker staff members and simplify the work of administrators. S.P.

N67-17879*# Chicago Univ., Ill. Graduate School of Business.

SOME DETERMINANTS OF ORGANIZATIONAL SUCCESS

Frank Stafford and Selwyn W. Becker [1965] 19 p refs Submitted for Publication

(Grant NsG-370)

(NASA-CR-70451) CFSTI: HC $3.00/MF $0.65 CSCL 05J

Attempts are made to measure the relative effect on organization efficiency of variables frequently associated with the disciplines of psychology, economics, and sociology. The purpose is to determine how much of the variance in organizational productivity can be explained by organization size, adoption of innovation, psychological distance in the management team, and environmental state. To measure psychological distance in the management team and the adoption of innovations the chief executives of over a hundred savings and loan associations were asked to fill out questionnaries. The dependent variable investigated was organization success, efficiency, or productivity. The different independent variables used were organization size, growth rate of the surrounding community, adoption of innovations, past profitability and psychological distance in the management team. S.P.

N67-17990*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.

DECISION-MAKING IN SMALL GROUPS—A SIMULATION STUDY

Geoffrey P. E. Clarkson May 1966 147 p refs

(Grant NsG-235)

(NASA-CR-81655) CFSTI: HC $3.00/MF $0.65 CSCL 05J

Research was conducted to develop a theory of group decision making behavior. Five problems were identified. The first concerned determining whether the basic unit for the theory ought to be the group or its individual members. The approach chosen was to focus upon the individual. The next question was to resolve how to determine the decision behavior of the individuals. The solution proposed was to give the theory of individual behavior the task of learning to behave like the subjects in question. The next two problems were concerned with identifying the leader-follower relation and the effects on decision behavior of the group decision process. The theory resolved the former by assigning as leader the more conservative member of each group. The effects of group participation are accounted for in the theory by self and interpersonal influence processes. The final problem was that of designing an experimental task and environment which would provide the requisite test data. The experiment used permits both individuals and groups to generate observable sequentially linked behavior. Subject behavior is task dependent. R.N.A.

N67-18014*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.

THE EFFECTS OF PERT ON R&D ORGANIZATIONS

Wyckham D. Seelig and Irwin M. Rubin Dec. 1966 16 p refs *Its* Working Paper 230-66

(Grant NsG-235)

(NASA-CR-81725) CFSTI: HC $3.00/MF $0.65 CSCL 05A

The study reported was conducted on projects in aerospace and electronics industries with contracts greater than $1 million. The methods of collecting information on cost and schedule performance, technical performance, and communication are described, and the results are tabulated and discussed. It was concluded that PERT leads to improvement of cost/schedule performance while at the same time technical performance is not noticeably affected. Improved communication with the use of PERT is also indicated. N.E.N.

N67-18082*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.

INFORMATION FLOW IN AN R AND D LABORATORY

Thomas J. Allen and Stephen I. Cohen Aug. 1966 29 p refs

(Grants NsG-235; NSF GN-233; NSF GN-353)

(NASA-CR-81753; Rept.-217-66) CFSTI: HC $3.00/MF $0.65 CSCL 05J

A sociometric study of interpersonal relations and information flow was conducted in a small research and development laboratory

engaged in work on new materials and devices in the fields of energy conversion and solid state electronics. The data were collected from 28 of the 34 professional members of the laboratory by means of written questionaire followed up by brief personal interviews. The results of the research provide substantial support for two hypotheses concerned with 1) the role of technological gatekeepers who are key individuals capable of effectively bridging the organizational boundary impedance and who provide the most effective entry point for ideas into the lab, and 2) the influence of primary groups in mediating the information flow. Various statistical percentage data compiled from the questionaires are given in tables, and the relations involving communication behavior are discussed. L.S.

N67-18105*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.

ANALYSIS OF PROBLEMS ENCOUNTERED IN R&D PROJECT MANAGEMENT

Roy Foust and Irwin Rubin Dec. 1966 26 p refs

(Grant NsG-235)

(NASA-CR-81761; Rept.-232-66) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Types and numbers of problems encountered in government-supported projects in the aerospace and electronics industries are analyzed by reviewing data on 32 research and development contracts. Frequencies of problems encountered by both project and laboratory managers were inversely related to the rankings of the importance of these problems, indicating that there may not be adequate reporting procedures. Rankings and frequencies of problems encountered by both project and laboratory managers are significantly correlated. Problem importance rankings associated with the job positions of project managers and of laboratory managers were not related. While the rankings of frequencies of problems by project managers and government technical monitors agreed, those for laboratory managers and monitors did not. A general problem category typology was developed from the data submitted on the 32 projects. M.W.R.

N67-18199*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE PROBLEM OF THE AGED SCIENTIFIC ORGANIZATION

E. R. Harrison 30 Nov. 1965 6 p Submitted for Publication

(NASA-TM-X-57084) CFSTI: HC $3.00/MF $0.65 CSCL 05J

The problem of the aged scientific organization, with its misinterpretation of the scientific spirit, its misdirection of scientific effort, and the attendant misuse of money is considered, and practical methods to tackle this problem are suggested. Emphasis is placed on the fact that a scientific organization can only endure and exist in a healthy state when its staff at all levels are engaged in making manifest the following factors: learning, the advancement of knowledge, teaching, and the application of ideas. A.G.O.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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